INVESTIGATIONS OF THE HISTORIC SOUTH RIVER WOOD DISTILLATION/CHARCOAL PLANT SITE

FINAL

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EXECUTIVE SUMMARY

CH2M HILL ENGINEERING LTD. has conducted a study of the historic South River Wood Distillation/Charcoal plant site. The primary objectives of the study were to establish the physical extent of contamination in soil, lake sediment, surface water and groundwater, and to identify existing health and environmental impacts. The scope was later expanded to include the location of a former disposal area for buried tar pond waste.

The field investigation included a surface mapping program, a preliminary diving inspection in nearby Forest Lake, a subsurface drilling and soil sampling program, and a well installation and groundwater sampling program.

The Village of South River is situated on a flat sand plain. This sand plain extends under the former plant site, and also forms the local water supply aquifer. The municipal water supply wells are located 300 m southwest of the former plant site.

Groundwater contaminated with high levels of polycyclic aromatic hydrocarbons (PAHs), phenolic compounds, and benzene, toluene, xylenes and ethyl benzenes (BTXE) is present under the former tar pit area in the north-central area of the site (Figure 3). This contamination is not laterally extensive as groundwater samples taken less than 100 m away from this area are not contaminated.

No PAH, phenolic, or BTXE contamination was detected in a sample from the South River Municipal Well #2.

In the central area of the site, soil contamination appears to be limited to the areas of a former tar pond and the oven house/holding tank house buildings (Figure 2). Areas of tar contamination exist on ground surface. Evidence of soil contamination in the subsurface was limited to strong odours.

Tar contamination exists on the bottom of Forest Lake in the near-shore area adjacent to the site. Lake sediments in this area are contaminated with high levels of PAHs. No significant contamination of the lake water was detected.

No significant vertical or horizontal hydraulic gradients were measured in the groundwater underneath the former plant area. Under these conditions, only slow groundwater movement is occurring across the site. The low horizontal hydraulic gradients make it difficult to determine the direction of groundwater flow underneath the site. The results of a two-dimensional groundwater flow model indicate that the site area likely lies within the capture zone of the municipal wells. The travel time for the observed contaminated groundwater under the former tar pond area to migrate to the municipal wells was predicted to be on the order of 25 years or longer.

Buried tar pond waste was found in three shallow trenches in the southwest area of the property, about 60 metres from the South River municipal wells. The wastes were buried above the water table.

Three primary exposure pathways for release of onsite contaminants have been identified. These are:

(i) migration of contaminated groundwater to the municipal wells,

(ii) direct contact with tars, soils, and lake sediments,

(iii) aquatic biota uptake of contaminants from lake sediments.

Typical remedial alternatives have been reviewed for each pathway.

Recommendations for further action have been made and include:

(i) A more extensive diving inspection/sediment sampling program in Forest Lake, and a program of bioassay (lethality) tests of lake sediment samples.

(ii) a groundwater monitoring program using the South River municipal wells, 3 existing monitor well nests, 2 proposed new well nests, and 1 proposed new shallow well. (Figure 7).

(iii) restricted access to the subject property

Remedial action, if any, for tar-contaminated surface soils and lake sediments should be evaluated after completion of the lake sediment investigation described in (i) above. Site decommissioning, according to MOE guidelines, should be undertaken before any development of this property proceeds.

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Section 1
INTRODUCTION

1.1 BACKGROUND ON PROJECT

In November 1988, the Ontario Ministry of the Environment (MOE) released an inventory of former industrial plant sites in Ontario producing or using coal and related tars (Intera Technologies Ltd., 1988). Forty-four sites were identified. For each site, the inventory documented general site characteristics and any preliminary indications of the presence of onsite wastes.

A major MOE program is now underway to more fully investigate the potential impacts that these sites may have on human health and the environment. The program is aimed at determining the need for remedial action at individual sites.

The former South River Wood Distillation/Charcoal Plant (Figure 1) was identified by the inventory as a former producer of wood tars and related wastes. Wastes including tars were found onsite.

In November 1989, the MOE initiated an investigation of the South River property. The primary concern on this site is the proximity of the former plant area to municipal water wells. Buried wastes on the plant property may impair the water quality of the wells. Another concern is the potential impact this site may have on a nearby lake. The site is located on the shore of Forest Lake.

1.2 SCOPE OF WORK AND OBJECTIVES

On November 9, 1989, the Ontario Ministry of the Environment issued a Request for Proposal (RFP) entitled 'Investigation of the Historic South River Wood Distillation/Charcoal Plant Site'. The objectives of this study, as outlined in the RFP, are as follows:

i) To establish the physical extent of waste, contaminated soils, sediments, surface water, and groundwater onsite and offsite.

ii) To identify existing impacts on public health and the environment and, where necessary, develop recommendations to mitigate or prevent these impacts.

The specific concerns with respect to the site were further detailed in the RFP as follows:

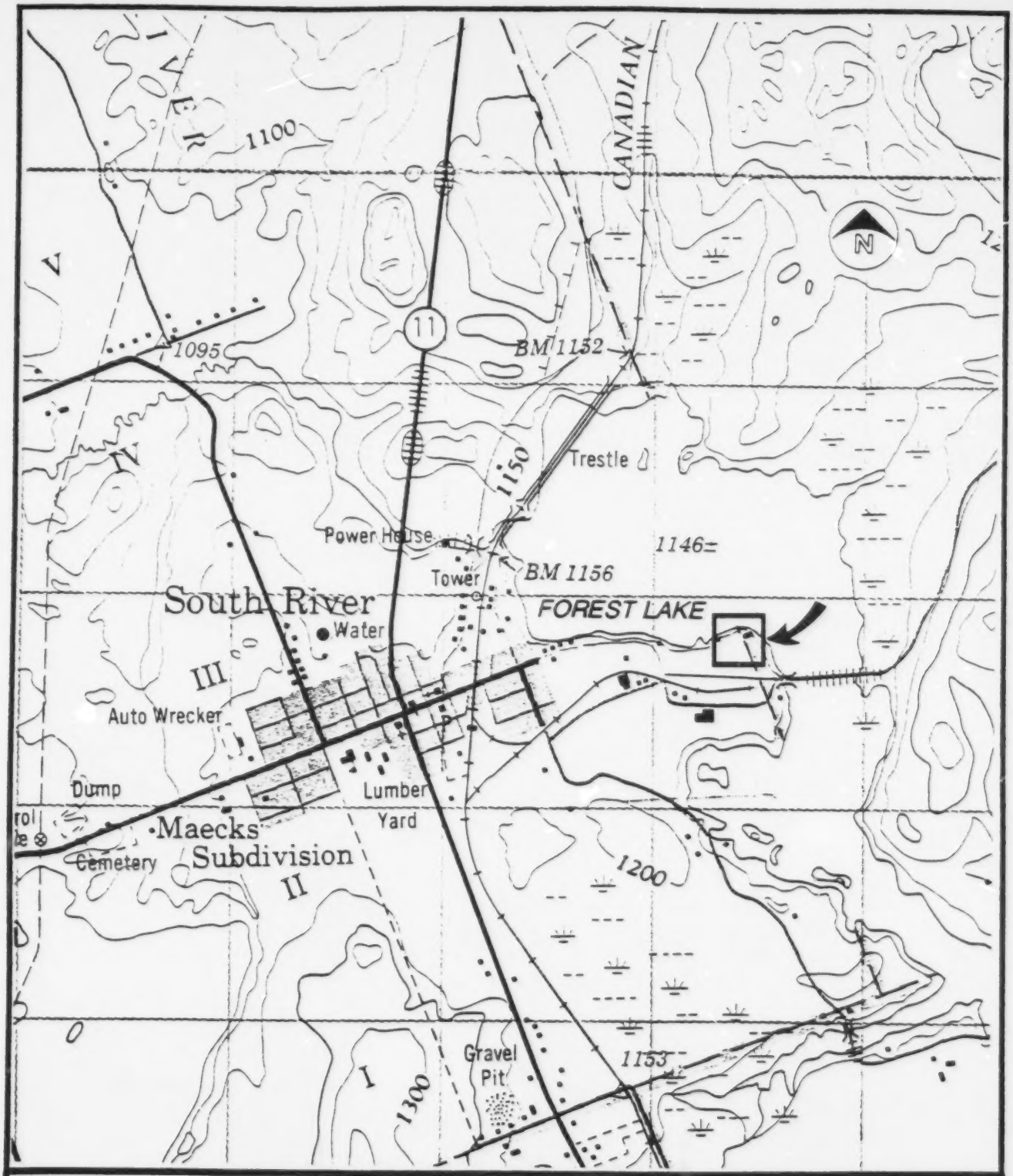

Figure 1: Location of the Former Wood Distillation/Charcoal Plant, South River

1. To determine the presence and extent of tar waste including other related by-products on the plant site, including the area adjacent to the South River (i.e. Forest Lake).

2. To determine the chemical characteristics of waste found at the site and close to the shore.

3. To determine the extent and degree of groundwater contamination associated with the wastes.

4. To determine the impact of contaminated groundwater on the South River (i.e. Forest Lake), and on the municipal well to the southwest. This will require characterization of the municipal aquifer in the area.

5. To determine the presence and extent of any waste related to the operation of the plant in Forest Lake and in the municipal aquifer.

6. To determine the impact on the surface water quality of Forest Lake from any waste found on the bottom of the lake.

After completion of the original field investigation, the scope of the project was expanded to include an investigation of previously buried tar pond wastes in unmarked, shallow disposal trenches on the property.

Section 2
METHOD

2.1 FIELD INVESTIGATION

The field investigation included a surface mapping program, a diving inspection in Forest Lake, a subsurface drilling and soil sampling program, and a well installation and groundwater sampling program. Detailed information on the field methods is presented in Appendix A.

A map of the site area was prepared using a reconnaissance survey and air photographs.

A preliminary diving inspection was conducted in Forest Lake, along one transect line located close to the shoreline adjacent to the former plant site. The bottom of the lake was examined for any visible tar and tar seepages into the surface water within the active sediment zone. Lake sediment and lake water samples were collected. Selected samples were analyzed chemically for polycyclic aromatic hydrocarbon compounds (PAHs) and phenolic compounds (Phenolics).

A drilling/soil sampling program was completed over the area of the former plant site. A total of nineteen boreholes were drilled. The boreholes were drilled in order to assess the presence of subsurface wastes, and to characterize the geological materials underneath the site.

Soil samples obtained during drilling were described in the field. Selected samples were analyzed chemically for PAHs and Phenolics. Four soil samples were submitted for grain-size analysis. Two soil samples were submitted for analysis of the organic carbon content.

A total of nine monitor wells were installed in selected boreholes. The monitor wells were placed so as to provide groundwater level measurements across the site, and to assess the chemical quality of groundwater underneath the site. The rationale for the placement of the wells is as follows:

i) **Upgradient (Background)**

- assess groundwater quality upgradient of the former plant site

ii) **Along the Bank of Forest Lake**

- determine the impact of potential plant wastes, (thought to exist along the bank) on groundwater quality

iii) **Across the Site**

- determine the impact of the former plant operation on groundwater quality by creating a profile across the site from Forest Lake to the municipal wells located to the southwest of the remnant foundation structures

- determine the potential for aqueous phase contaminants to migrate vertically through the assumed impermeable clayey deposits beginning at 20 metres below ground surface.

The groundwater level (i.e depth to water table) was measured in all onsite monitor wells and in an observation well adjacent to the South River municipal wells. The water level in the lake was also measured. All measurements were "tied in" by a survey to a common reference elevation.

Groundwater samples from seven onsite monitor wells and from one of the municipal wells were collected and chemically analyzed for benzene, toluene, xylene, and ethylbenzene (BTXE), PAHs and Phenolics.

Samples of the waste tar were collected from ground surface onsite and from the lake bottom close to shore. Tar samples were chemically analyzed for PAHs, Phenolics, and BTXE.

Section 3
SITE DESCRIPTION

3.1 HISTORICAL DESCRIPTION

The former wood distillation/charcoal plant (see Figure 1) is located on the east side of the town of South River, close to Ottawa Avenue. The site is situated on the shore of Forest Lake. The South River municipal wells (Wells #1 and #2) are about 300 m to the southwest of the site.

The wood distillation plant was used to make wood chemicals such as acetic acid, acetone, methyl alcohol, creosote oils and wood tars. From 1903 to 1954 the facility was operated as a wood distillation plant by the Standard Chemical Company Ltd. Beaver Charcoal, a division of Charcoal Supply and Sales of Ontario Ltd. operated the plant to make charcoal from 1955 to 1967.

The products of the wood distillation plant were formed by combustion and distillation processes. Wood was placed by hand, or later via rail "buggies", into brick or steel and brick ovens. The wood was then burned in the absence of air, and the gaseous products of the combustion were collected and condensed into tar and alcohols ("raw liquor"). The wood residue was charcoal.

After burning, the charcoal was placed in air-tight iron charcoal coolers. Once cooled, charcoal was moved to storage areas.

The raw liquor was pumped to holding tanks. Originally, the liquor was likely further refined by onsite distillation into alcohols, acids, oils and a tar residual. Lime and sulphuric acid were likely used to produce acetic acid from the raw acids. Acetate was an intermediate product in this process. The hot tar residual was cooled and pumped to tar tanks or pits for storage. Records of the Ontario Water Resources Commission indicate that by 1964, the raw liquor was trucked to chemical plants in the United States for refinement.

CH2M HILL has prepared detailed site plans using a 1908 fire insurance plan, and air photographs from 1929, 1969 and 1987 (see Figures 2 and 3 in map pocket). Figure 2 has been prepared to show the following:

i) The facilities as of 1908, which includes coal sheds, oven house, holding tank house, storage tanks, lime house, storage buildings, oil store house and acetate storage area.

ii) The South River (i.e. Forest Lake) adjacent to the site.

A tar pit was known to exist on the property in 1977 (Intera Technologies Limited, 1988). A 1969 air photograph shows the tar pit located 20 or 30 m from the shore of Forest Lake, in the north-central area of the site (Figure 4).

In 1978, the area onsite, close to the lake shore, including the tar pit, was excavated under MOE direction (MOE, personal communication). Liquid waste was removed from the site by CPW Disposal Ltd. of Barrie, Ontario. Contaminated soil was excavated and re-buried onsite in three shallow trenches in the western part of the property as shown on Figure 3.

Presently, the site is vacant with only remnants of the former plant (i.e. rubble and foundations). To the west of the site on Ottawa Avenue are residential houses. To the south and southwest are several commercial businesses. Figure 3 shows the current features of the site, including:

i) locations of foundations and rubble from former buildings

ii) tar visible on the ground surface

iii) locations of monitor wells and boreholes emplaced for this study.

iv) location of the municipal water supply wells southwest of the site.

Development of this property for recreational and residential use has been under consideration since 1977 (Intera Technologies Ltd., 1988).

In November 1989, the MOE obtained samples of raw (i.e. untreated) water from the South River Municipal Wells #1 and #2, and a sample of treated water from Well #2. The water samples were analyzed for inorganic and organic samples including major ions, metals, total phenolics, microbiological parameters, and a range of organic compounds. The results are included in Appendix I. It is pertinent to note that the concentration of total phenolic compounds in each water sample was less than 0.6 ppb, indicating no detectable contamination by phenolic compounds. As well, there was no detectable contamination by any of the other tested organic parameters.

3.2 GEOLOGY

The South River area is located in the physiographic region known as the Number 11 Strip (Chapman and Putnam, 1984). This region is characterized by sand, silt and clay deposits which infill the hollows between bedrock knobs and ridges.

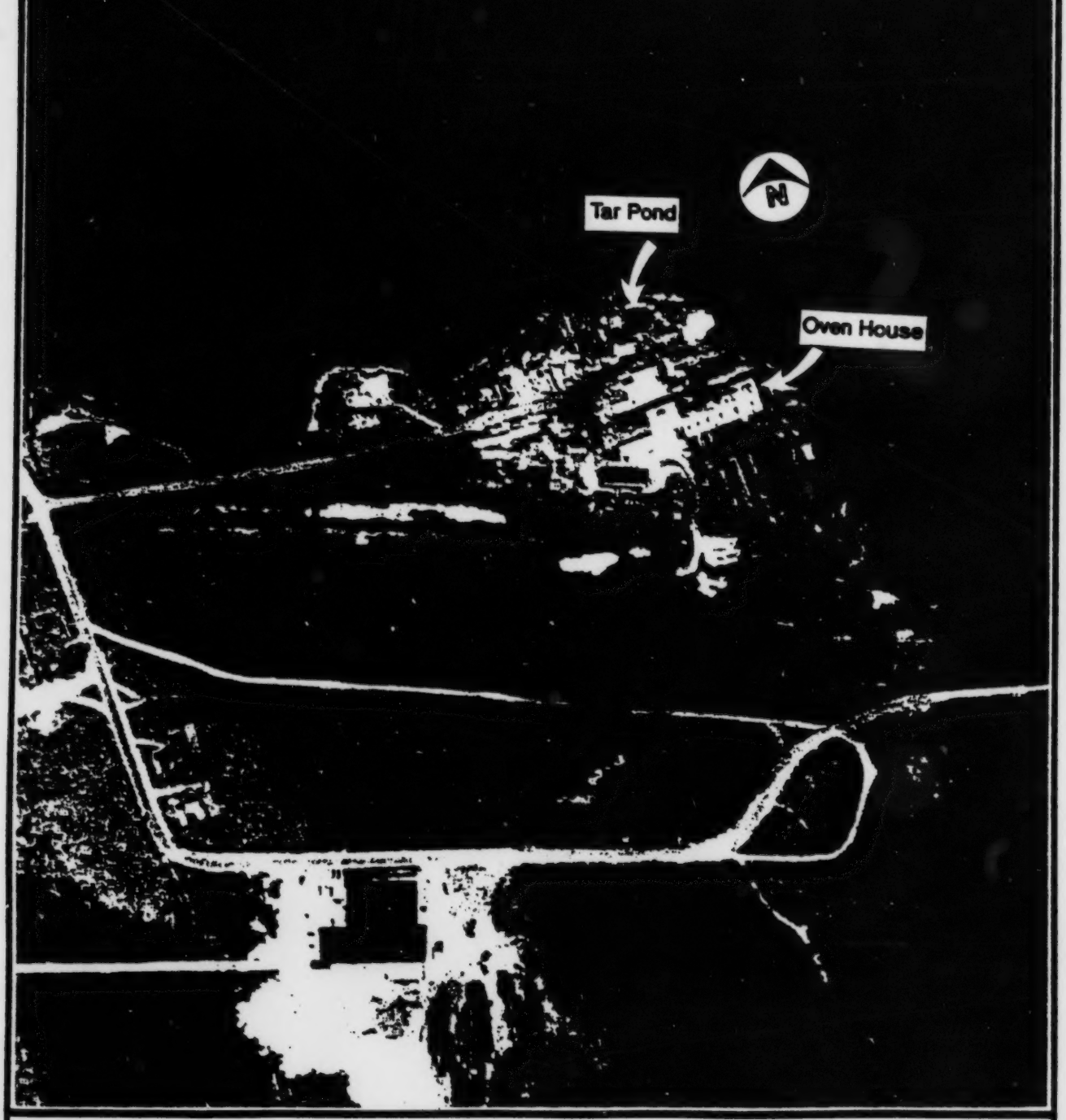

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Figure 4: Air Photograph of Plant Site, 1969

The village of South River is situated on a flat sand plain. The plain is composed of deltaic sands which were deposited by streams entering glacial Lake Algonquin. The sand plain was formed during the recession of the Wisconsinan Glacier (Chapman and Putnam, 1984).

Underlying the sand plain, and outcropping to the north and south of the village, is Precambrian granite and gneiss bedrock.

A buried bedrock valley runs underneath the village (Figure 5). The buried valley trends east-west, is approximately 1 km wide, and presumably extends underneath Forest Lake. The depth to bedrock is up to 85 m in the deepest parts of the buried valley. The overburden filling the valley is up to 60 m of clay, silt, sand and boulders, overlain by up to 25 m of primarily fine to coarse sand. The location of the buried valley was defined using local water well records (Geo-Environ, 1978) and geophysical resistivity surveys conducted in 1977 by the MOE (unpublished report, MOE files).

The area of the former plant site and the municipal wells is underlain by at least 20 m of well sorted, fine to coarse sand. The log of a test well in the vicinity of the municipal water supply wells indicates that this clean sand is underlain by a clayey sand (Geo-Environ, 1978). Figure 6 is a geological cross section of the site area. The location of the cross-section is shown on Figure 3.

Boreholes drilled on the former plant site confirmed that the site is underlain by at least 20 m of sand. The borehole logs are presented in Appendix C. The sand is relatively homogeneous, showing little variation between boreholes or with depth. The sand is fine to coarse grained and well sorted. Grain size analyses are presented in Appendix G. The sand has a low organic matter content, as is indicated by an organic carbon content (f_{oc}) of approximately 0.0003 (Appendix E).

3.3 HYDROGEOLOGY

3.3.1 THE SOUTH RIVER WATER SUPPLY WELLS AND AQUIFER

The sand plain in the area of the Village of South River forms the local water supply aquifer. The aquifer is an unconfined, or water-table aquifer.

The sand aquifer follows the east-west trend of the buried bedrock valley. In the centre of the bedrock valley, near the location of the municipal water supply wells, the aquifer is over 20 m thick. The aquifer is hydraulically connected to Forest Lake, meaning that water can move relatively freely between the lake and the aquifer.

Pumping tests conducted between 1978 and 1983 (Geo-Environ, 1978; Geo-Environ, 1983; Morrison Beatty Ltd., 1981) indicate the following aquifer characteristics:

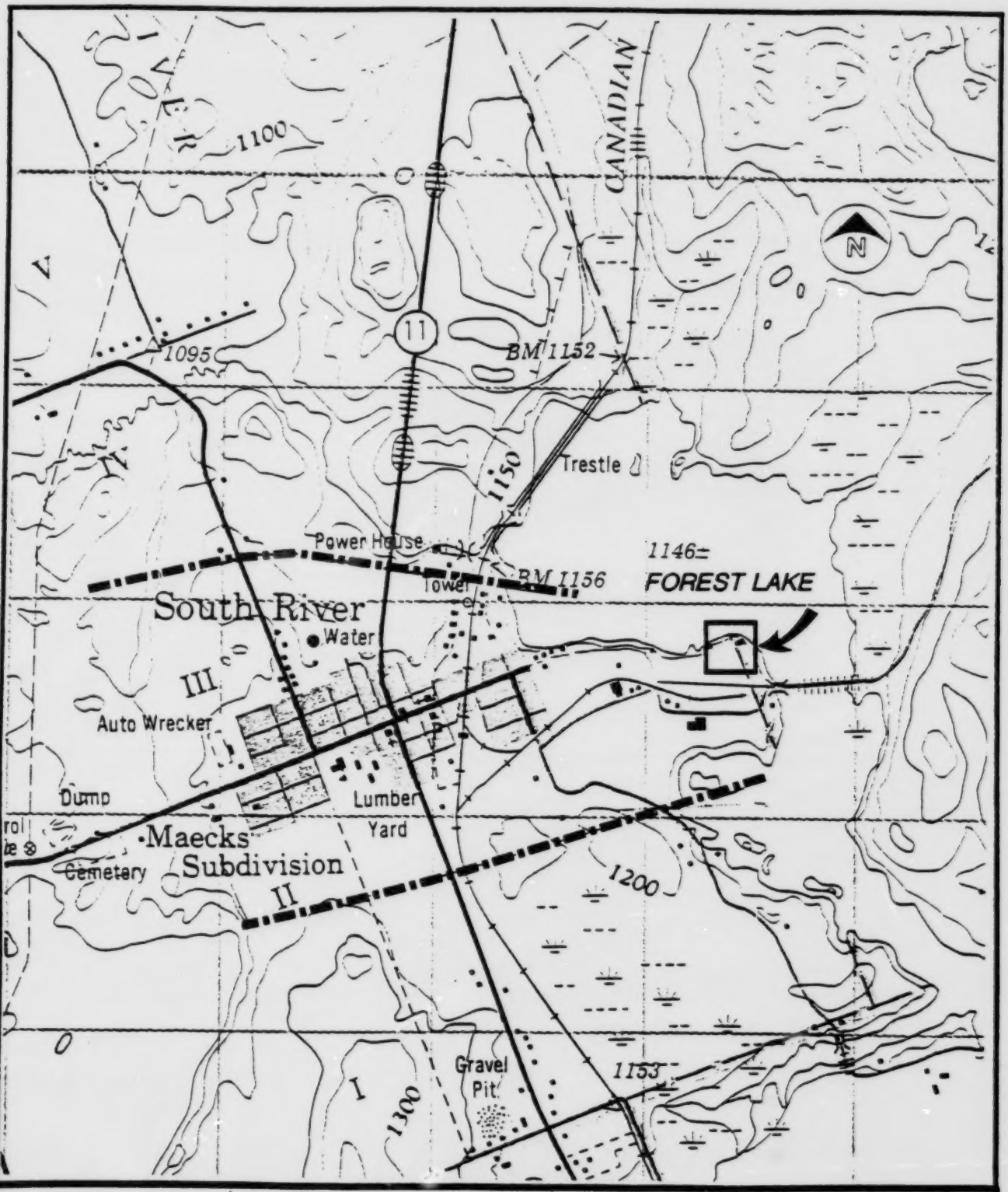

Figure 5: Location of Buried Bedrock Valley, South River Area

Transmissivity: 3.5×10^{-2} m^2/s
Specific Yield: 0.02 to 0.1

Presently, one of the South River municipal wells is pumped intermittently at approximately 20 L/s. Operation is switched between Well #1 and Well #2 from day to day. In August 1990, the operating well was typically turned on and off once every one or two hours. From September 1989 to August 1990, the South River municipal wells pumped a total of 141,434 m^3 of water (Township Office, personal communication). Water pumpage was highest in late summer and fall, and lowest in winter.

3.3.2 GROUNDWATER FLOW UNDER THE SITE AREA

Water level elevations in the onsite monitor wells were measured in August 1990. Water level measurements were also made in an observation well near the municipal water supply wells, and in Forest Lake. The results are presented in Table 1. Water levels recorded on August 30, 1990 are also recorded on Figure 7. (The August 30th lake water level in Forest Lake was estimated by assuming a similar change in the elevation of the water table and of the lake level between August 20 and August 30).

The water table under the study area was between 4 and 5 m below ground surface in August 1990. These water levels were not observed to fluctuate in response to pumpage of the municipal wells. However, continuous water level monitoring over a period of at least one day, on at least one onsite monitor well, is needed to confirm this observation.

The horizontal hydraulic gradient (ie. slope of the water table) across the plant site was essentially zero. In other words, the difference in groundwater elevation from place to place across the site was on the order of a few centimetres. These small differences may be partly the result of imprecision associated with the field measurements. Based on these measurements, it is not possible to determine a direction of groundwater flow underneath the site. However, the negligible horizontal hydraulic gradient indicates that, at the time of observation, there was very little horizontal groundwater movement across the site.

No vertical hydraulic gradient was measured at any of the three well nests onsite. This indicates that at the time of observation there was no significant upward or downward component of groundwater flow underneath the site.

The water level in Forest Lake was essentially the same as the water table elevation underneath the former plant site. This indicates very little movement of water into or out of the lake via the sand aquifer underneath the site was occurring at the time of observation.

The hydraulic conductivity, or permeability, of the sand aquifer in the study area was estimated using three methods: pumping test analysis, hydraulic response (slug) tests, and grain size analysis of soil samples. The results are presented in Table 2. The

Table 1
WATER LEVEL ELEVATIONS

Well	Ground Elevation*	Meas. Pt Elevation*	August 17, 1990		August 20, 1990		August 30, 1990	
			Depth to Water	Water Elevation*	Depth to Water	Water Elevation*	Depth to Water	Water Elevation*
MWN1A	99.03	99.76	4.22	95.52	4.22	95.52	4.29	95.47
MWN1B	99.35	100.03	4.49	95.54	4.49	95.54	4.56	95.47
MWN2A	99.66	100.54	4.89	95.65	4.89	95.65	4.96	95.58
MWN2B	99.67	100.51	4.87	95.64	4.86	95.65	4.93	95.58
MWN3A	99.54	100.34	4.70	95.64	4.71	95.63	4.77	95.57
MWN3B	99.44	100.39	4.75	95.64	4.75	95.64	4.82	95.57
MWS1	99.54	100.34	4.69	95.65	4.69	95.65	4.76	95.58
MWS2	99.29	100.17	4.68	95.49	4.68	95.49	4.75	95.42
MWS3	99.91	100.59	4.96	95.63	4.96	95.63	5.03	95.56
TW5-78	100.05	100.66	-	-	-	-	4.94	95.72
Forest Lake				95.65	-	(estimated - 95.65)		(estimated 95.58)

* All elevations referenced to floor of pumphouse, Municipal Well #1, which was arbitrarily assigned an elevation of 100.00 m.

values calculated from slug tests represent the low end of the range of values of hydraulic conductivity of the subsurface materials around the monitor wells. At many monitor wells, slug tests were not successful due to the high hydraulic conductivity of the materials at these locations, causing the immediate recovery of the water level during the test. The average hydraulic conductivity was estimated to be 2×10^{-3} m/s. This value is typical of a clean sand deposit (Freeze and Cherry, 1979), and indicates a relatively high permeability.

Table 2
HYDRAULIC CONDUCTIVITY OF THE SAND AQUIFER

Location	Hydraulic Conductivity (m/s)	Method of Calculation
MWN3A	9×10^{-5}	Slug Test[1]
MWN1B	2×10^{-4}	Slug Test[1]
MWS2	8×10^{-4}	Slug Test[1]
MWN2A	3×10^{-4}	Slug Test[1]
BHS4 (2.5-3.0 m)	1×10^{-2}	Hazen[2]
MWS1 (1.7-2.2 m)	4×10^{-3}	Hazen[2]
BHS9 (4.0-4.5 m)	1×10^{-2}	Hazen[2]
Area of Municipal Wells	2.2×10^{-3}	Pumping Tests[3]

NOTES:

[1]See Appendix D. Analysis by the method of Bouwer and Rice, 1976

[2]See Appendix G. Analysis by the method of Hazen (Freeze and Cherry, 1979).

[3]From Geo-Environ Ltd, 1978; Geo-Environ Ltd, 1983; and Morrison Beatty Ltd., 1981.

Because the sand aquifer has a high permeability, groundwater can move relatively quickly through this aquifer if a significant hydraulic gradient exists. However, as discussed above, the vertical and horizontal hydraulic gradients across the site are very small. This means that, under the observed water level conditions, only slow groundwater movement is occurring across the site. However, increased pumping of the municipal wells could induce groundwater movement from the site area to the wells.

3.3.3 GROUNDWATER FLOW BETWEEN THE SITE AND THE MUNICIPAL WELLS

The water table elevation at well TW5-78, close to the municipal wells, was measured several times on August 30, 1990. The water level in this well fluctuated in response to pumping of the municipal wells. When the municipal wells were not operating, the water level elevation rose to 95.72 m above reference. About two minutes after Well

#1 began pumping (at approximately 20 L/s), the water level in TW5-78 had dropped by 0.42 m.

Based on these measurements, when the municipal wells are not pumping, normal groundwater flow in the study area appears to be in a northeast direction, ie. from the area of the municipal wells to the area of the plant site and the lake. However, when either municipal well is pumping, this flow direction is reversed, at least in the vicinity of the municipal wells.

The low horizontal hydraulic gradients underneath the former plant site make it difficult to determine the direction of groundwater flow underneath the site. In August 1990, the flow of groundwater under the site was very slow. However, the sand aquifer has a high permeability. This means that if the hydraulic gradient toward the pumping wells was increased, (for instance by an increase in pumpage or a decrease in precipitation), there is the potential that significant groundwater flow from the site to the wells will result.

The observed groundwater flow patterns in the study area may change with changes in precipitation, river stage, or pumping rates of the municipal wells. It is pertinent to note that conditions in August 1990, (low precipitation, high pumping rates) would result in a larger drawdown cone around the municipal wells than would occur at other periods during the year. Nevertheless, regular monitoring of the water levels in onsite and offsite wells, and in the lake, would help to confirm the direction of groundwater flow in the vicinity of the site.

Section 4
EXTENT OF CONTAMINATION

4.1 FOREST LAKE

4.1.1 LAKE SEDIMENT

Significant areas of the lake bottom adjacent to the site were found to be covered in tar. The extent of visually identified tar contamination in Forest Lake is shown in Figure 7. There were no visually identified areas of ongoing tar seepage into the lake.

The physical appearance of the tar, and its location overlying the lake bottom sediments, suggests that the tar was deposited in the lake by overland transport. There was no visible evidence that tar had entered the lake via upward movement through the lake sediments.

The tar on the surface of the lake bottom occurred as a stiff to crumbly "crust", up to 5 cm in thickness. In the central part of the tar-contaminated area, a fluid, sticky tar was also present underneath the tar "crust". The fluid tar, up to 10 cm in depth, was moderately viscous and more dense than water. Both types of tar were dark brown in colour and had a strong "wood smoke" odour.

Outside the tar-covered area, most lake-sediment samples were classified as exhibiting traces of contamination ("TC"). The sediment often contained cinders and usually had a distinct wood smoke odour.

The results of chemical analyses of selected lake-sediment samples are presented in Appendix E and summarized in Table 3. The field classification of samples (NC, TC, or VC) was compared to the results of chemical analysis. The comparison can be summarized as follows:

"VC" samples:	high concentrations of PAHs, similar to or greater than PAH concentrations in tar samples.
"TC" samples:	most samples show significant levels of PAHs.
"NC" samples:	similar level of PAH contamination to TC samples.

None of the lake sediment samples contained detectable levels of phenolic compounds. Phenolics have moderately high solubilities in water and were likely leached out of the lake sediment samples by the lake water.

The lake sediment core sample (1+60 core), collected from 5 to 10 cm below the sediment surface, is not significantly contaminated with PAHs.

Table 3
SUMMARY OF COMPOUNDS FOUND IN LAKE SEDIMENT SAMPLES (ppb)

Sample	0+00	0+40	1+20	1+60	2+00	2+40	2+80	Lab Blank	Detect. Limit*
Field Classification	NC	TC	TC	core TC	TC	VC	VC		
Compound									
Phenolics (Coal Tar Acids)									
Phenol	<	<	<	<	<	<	<	<	8.0
o-Cresol	<	<	<	<	<	<	<	<	8.0
m-Cresol	<	<	<	<	<	<	<	<	8.0
p-Cresol	<	<	<	<	<	<	<	<	8.0
2,6-Dimethyl phenol	<	<	<	<	<	<	<	<	8.0
2,5-Dimethyl phenol	<	<	<	<	<	<	<	<	8.0
2,4-Dimethyl phenol	<	<	<	<	<	<	<	<	8.0
3,5-Dimethyl phenol	<	<	<	<	<	<	<	<	8.0
2,3-Dimethyl phenol	<	<	<	<	<	<	<	<	8.0
3,4-Dimethyl phenol	<	<	<	<	<	<	<	<	8.0
Resorcinol	<	<	<	<	<	<	<	<	8.0
PAHs									
Naphthalene	194	248	10.2	17.6	776	39000	59100	<	24.0
Acenaphthylene	67.2	<	7.7	<	66.0	13400	<	<	9.6
Acenaphthene	45.1	<	<	15.5	139	16300	23800	<	9.6
Fluorene	127	70.6	5.6	22.4	285	68500	97100	<	9.6
Phenanthrene	362	134	36.0	10.3	842	50100	70700	<	3.2
Anthracene	94	30.8	9.90	<	165	24800	6790	<	4.8
Fluoranthene	536	117	78.4	13.6	975	14900	20000	<	8.0
Pyrene	672	127	89.9	<	1060	28100	37800	<	8.3

Table 3
SUMMARY OF COMPOUNDS FOUND IN LAKE SEDIMENT SAMPLES (ppb)

Sample	0+00	0+40	1+20	1+60	2+00	2+40	2+80	Lab Blank	Detect. Limit*
Benzo(a)anthracene	256	38.4	40.8	<	399	<	10300	<	33.6
Chrysene	281	47.5	42.4	<	405	<	11100	<	33.6
Benzo(b)fluoranthene	280	35.8	43.5	<	370	<	<	<	22.4
Benzo(k)fluoranthene	225	25.6	34.8	<	265	<	<	<	22.4
Benzo(a)pyrene	214	25.1	35.5	<	319	<	4800	<	19.2
Indeno(1,2,3-cd)pyrene	258	24.7	37.1	<	292	<	<	<	24.0
Dibenzo(ah)anthracene	35.9	<	<	<	19.7	<	<	<	19.2
Benzo(ghi)perylene	234	19.5	29.3	<	224	<	<	<	19.2
Total PAHs	3881	944	501	79	6602	255100	341940		
BNA (including PAH repeats)									
Naphthalene	193	290	7.16	18.1	687	39800	70100	<	1.6
Acenaphthylene	70.9	<	5.52	<	50.8	9250	<	<	3.2
Acenaphthene	63.2	<	<	14.0	163	20900	31600	<	3.2
Fluorene	190	112	7.90	31.5	425	132000	207000	<	3.2
Phenanthrene	430	164	40.5	10.2	993	68800	98500	<	1.6
Anthracene	96.2	29.6	7.62	<	156	30700	46800	<	1.6
Fluoranthene	519	92.3	71.3	5.73	924	16200	21200	<	1.6
Pyrene	557	107	74.7	10.3	850	24500	32600	<	1.6
Benzo(a)anthracene	214	33.0	30.2	<	344	<	9100	<	1.6
Chrysene	253	41.8	32.2	<	377	<	9600	<	17.6
Benzo(b)fluoranthene	277	35.2	40.2	<	381	<	<	<	3.2
Benzo(k)fluoranthene	238	27.1	38.8	<	306	<	<	<	1.6
Benzo(a)pyrene	195	25.4	34.1	<	336	<	7040	<	1.6

Table 3
SUMMARY OF COMPOUNDS FOUND IN LAKE SEDIMENT SAMPLES (ppb)

Sample	0+00	0+40	1+20	1+60	2+00	2+40	2+80	Lab Blank	Detect. Limit*
Indeno(1,2,3-cd)pyrene	237	21.8	40.7	<	305	<	<	<	1.6
Dibenzo(ah)anthracene	31.9	<	<	<	31.6	<	<	<	1.6
Benzo(ghi)perylene	305	36.3	33.5	<	323	<	<	<	1.6
Camphene	<	<	<	118	<	<	<	<	368
2-methylnaphthalene	353	437	10.7	13.2	1140	156000	24900	<	3.2
1-methylnaphthalene	215	227	8.82	13.2	908	110000	17400	<	3.2
Biphenyl	100	166	<	7.51	149	23000	35200	<	3.2
Benzybutylphthalate	56.8	44.5	72.4	35.7	26.6	4750	<	<	3.2
Di-n-butylphthalate	88.3	113	95.9	79.7	81.4	<	1650	0.26	3.2
Perylene	82.2	9.18	12.2	296	123	<	<	<	1.6

* The following samples have higher detection limits:
2+40 184 x higher
2+80 60 x higher

Concentrations in ppb
N/A: not analyzed

All laboratory analysis of compounds in the lake sediment samples are reported on a "wet-weight" basis. Regulatory guidelines are reported on a "dry-weight" bases. As a result, there is a slight underestimation of the compound concentrations with respect to guidelines. For example, assuming a soil moisture content of 20 percent by weight. "wet-weight" concentrations must be multiplied by 1.25 to give the equivalent "dry-weight" concentration. These discrepancies in concentration units are not expected to be significant when compared to the uncertainties associated with the sediment sampling process. No adjustment has been made to convert "wet-weight" to "dry-weight" measurements.

There are few regulatory guidelines for acceptable concentrations of PAHs in lake sediments. The Great Lakes Science Advisory Board has developed a guideline maximum concentration of benzo(a)pyrene in lake sediment of 1000 ppb, (CCME, 1989). One lake sediment sample (2+80) exceeds this guideline. The MOE adopted a site-specific guideline for a site near Port Stanley, Ontario, for total PAH in creek sediment (CANVIRO Consultants, 1988). A total PAH concentration of 35,000 ppb was used to delineate sediment requiring remediation. Two samples (2+40 and 2+80) contained total PAH concentrations which exceeded this guideline.

The draft Ontario Provincial Sediment Quality Guidelines (SQG) list a Lowest Effect Level (LEL) and Severe Effect Level (SEL) for total PAH in sediments (Persaud et al, 1990). The SEL is given as 11,000 μg per g of organic carbon. Assuming a total organic carbon (TOC) concentration in the sediments of 5 percent, the SEL is 550,000 ppb. Samples 2+40 and 2+80 contain total PAHs at levels close to this value. Given the incertainty in the sediment TOC, these samples are considered to be at the SEL. The LEL is given as 2,000 ppb. Samples 0+00, 2+00, 2+40, and 2+80 contain total PAHs which exceed the LEL. According to the SQG, the sampled sediments will impair sediment use by benthic organisms, and are slightly to highly contaminated.

According to the above, lake sediment in the immediate area of the visible tar contamination in Forest Lake is significantly contaminated with PAHs.

4.1.2 LAKE WATER

Lake water samples were collected at two locations: off-shore near MWN1 (location #1), and off-shore near MWS1 (location #2). These locations are shown on Figure 3. The analyses of these samples are given in Table 4.

No significant contamination of the lake water was detected. No parameter was measured at concentrations exceeding drinking water criteria (Table 4). Trace levels of Cresols and Dimethyl phenols were detected in one sample. There are no applicable drinking water criteria for these compounds. Parameters analyzed were PAHs, Phenolics, and BNA compounds (see Appendix E).

Table 4
SUMMARY OF COMPOUNDS DETECTED IN GROUNDWATER AND SURFACE WATER SAMPLES (ppb)

Compound	MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MWS1	MWS1 Repeat	MWS2 Repeat	Forest Lake #1	Forest Lake #2	Munic. Well #2	Travel Blank	Lab Blank	Det. Limit[a]	Water Quality Notes
BTXE															
Benzene	215	<	<	<	<	<	<	<	<	<	<	<	<	0.4	5 a
Toluene	570	<	<	<	<	<	<	<	<	<	<	<	<	0.7	24 b
m&p Xylene	330	<	<	<	<	<	<	<	<	<	<	<	<	0.6	300 b'
Ethyl benzene	210	<	<	<	<	<	<	<	<	<	<	<	<	2.6	2.4 b
o Xylene	155	0.5	<	<	<	<	<	<	<	<	<	<	<	0.4	300 b'
Phenolics (Coal Tar Acids)															
Phenol	638	0.35	0.53	0.68	0.29	0.20	0.23	0.57	0.38	0.26	0.21	0.22	<	0.07	2 c"
o-Cresol	1820	0.62	0.07	0.33	<	<	<	<	0.14	<	<	<	<	0.07	2 c"
m-Cresol	(2000)	0.14	<	0.42	<	<	<	<	0.28	<	<	<	<	0.07	2 c"
p-Cresol	(3700)	0.19	0.12	0.28	<	<	<	<	0.14	<	<	<	<	0.07	2 c"
2,6 Dimethyl phenol	5520	1.47	<	<	<	<	<	<	<	<	<	<	<	0.07	2 c"
2,5 Dimethyl phenol	3420	<	<	0.11	<	<	<	<	0.09	<	<	<	<	0.07	2 c"
2,4 Dimethyl phenol	5750	<	<	0.11	<	<	<	<	0.11	<	<	<	<	0.07	2 c"
3,5 Dimethyl phenol	4360	2.54	<	0.16	<	<	<	<	0.25	0.53	<	<	<	0.07	2 c"
2,3 Dimethyl phenol	1450	<	<	<	<	<	<	<	<	<	<	<	<	0.07	2 c"
3,4 Dimethyl phenol	1180	<	<	0.08	<	<	<	<	<	<	<	<	<	0.07	2 c"
Resorcinol	199	<	<	<	<	<	<	<	<	<	<	<	<	0.07	2 c"
PAHs															
Naphthalene	10.5	4.14	0.039	0.035	0.030	<	<	0.038	0.060	<	0.032	0.078	<	0.015	0.2 d
Acenaphthene	<	0.32	<	<	<	<	<	<	<	<	<	<	<	0.006	20 e
Fluorene	<	0.38	<	<	<	<	<	<	<	<	<	<	<	0.006	
Fluoranthene	<	<	<	<	<	<	<	<	0.008	0.010	<	<	<	0.005	0.1 f
Pyrene	<	<	<	<	<	<	<	<	0.008	0.010	<	<	<	0.005	0.2 d

Table 4
SUMMARY OF COMPOUNDS DETECTED IN GROUNDWATER AND SURFACE WATER SAMPLES (ppb)

Compound	MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MWS1	MWS1 Repeat	MWS2 Repeat	Forest Lake #1	Forest Lake #2	Munic. Well #2	Travel Blank	Lab Blank	Det. Limit*	Water Quality Notes
BNA (including PAH repeats)															
Naphthalene	10.6	3.56	<	<	<	<	<	<	<	<	<	<	<	0.01	0.2 d
Acenaphthene	<	0.25	<	<	<	<	<	<	<	<	<	<	<	0.02	20 e
Fluorene	<	0.44	<	<	<	<	<	<	<	<	<	<	<	0.02	
Fluoranthene	<	<	<	<	<	<	<	<	<	<	<	<	<	0.01	0.1 f
Pyrene	<	<	<	<	<	<	<	<	<	<	<	<	<	0.01	0.2 d
Phenol	1470	0.49	8.45	0.92	0.58	0.31	0.31	0.86	0.67	0.52	0.44	0.34	<	0.06	2 c"
2,4-Dimethylphenol	(18000)	2.00	0.44	0.56	<	<	<	<	0.73	<	<	<	<	0.08	2 c"
2-Methylnaphthalene	3.05	<	0.03	0.02	<	<	<	<	0.02	<	<	<	<	0.02	
1-Methylnaphthalene	2.55	1.88	<	<	<	<	<	<	<	<	<	<	<	0.02	
Total Diphenylamine	<	0.04	0.14	0.04	<	<	<	<	<	<	<	<	<	0.02	
Biphenyl	<	0.64	<	<	<	<	<	<	<	<	<	<	<	0.02	
Benzylbutylphthalate	<	0.93	1.16	1.05	0.48	0.67	0.44	0.49	0.23	0.30	0.12	0.33	<	0.02	
Di-n-butylphthalate	9.77	0.38	0.43	0.28	0.26	0.47	0.29	0.23	0.51	0.66	0.47	0.21	0.26	0.02	

* Detection limit for MWN1A is 100x higher
All concentrations in ppb

Water Quality Limits:
a - Health and Welfare Canada (1987), Maximum Allowable Concentration
b - Health and Welfare Canada (1987), Asthetic Objective
c - Ontario Ministry of the Environment (1984), Maximum Desirable Concentration
d - CCME (1989), Guideline A
e - USEPA Ambient Water Quality Criteria (CCME, 1989)
f - Quebec criteria A (CCME, 1989)
NOTES:
' - limit applies to total xylenes
" - limit applies to total phenols

4.2 SOIL SAMPLES

Small areas of surface tar contamination were identified over the central portion of the site. These areas are shown on Figure 7. This tar had a stiff, sticky to crumbly consistency, a dark brown colour, and a strong "wood smoke" odour. The tar was typically found from ground surface to depths of up to 5 cm below ground surface.

Of the eleven boreholes drilled onsite, only three boreholes encountered subsurface material which appeared contaminated. The locations of the boreholes are shown on Figure 7. These were:

MWN1A — Located in the area of the former tar pond (See Figure 3). At a depth of 17 m below surface, the sand had a strong odour.

BHS7 — Located northeast of the former oven house (See Figure 2). At a depth of 3.5 m below surface, there were streaks of black sand and a distinct odour.

BHS11 — Located west of the former holding tank house (Figure 2), in the centre of the site. At a depth of 2 m to greater than 4 m below surface, the sand had a strong odour.

The results of chemical analyses of selected soil samples are presented in Table 5. The results were compared to the field classification of samples. This comparison can be summarized as follows:

"TC/VC" samples:

PAH contamination is present. Several PAH compounds are found at concentrations which exceed CCME criteria A, indicating that the soil is "slightly contaminated" (Appendix H). No PAH compounds exceed CCME criteria B. No Phenolic compounds were detected.

"NC" samples:

PAH compounds were detected only at "background" levels. No PAH compound was found at concentrations exceeding CCME criteria A, and the samples can be considered uncontaminated. No Phenolic compounds were detected.

Soil contamination delineated during the drilling program was limited to the central area of the plant site, close to the former tar pit and the oven house/holding tank house buildings. Evidence of contamination in the subsurface was limited to strong odours. None of the boreholes onsite intersected soil which contained free-phase oil or tar.

Table 5
SUMMARY OF COMPOUNDS DETECTED IN SOIL SAMPLES (ppb)

Sample	BHS6 (3.5m)**	BHS7 (2m)	BHS11 (3.5m)	MWN3B (5m)	MWN3A (17m)	Lab Blank	Detect. Limit	Conc. Limit
Field Classification	NC	TC	TC/VC	NC	NC			
Compound*								
PAHs								
Naphthalene	<	234	82.8	<	<	<	24	50,000 a
Acenaphthylene	<	54.8	19.6	<	<	<	9.6	
Acenaphthene	<	74.1	11.4	<	<	<	9.6	
Fluorene	<	288	21.8	<	<	<	9.6	
Phenanthrene	7.18	456	119	12.0	12.6	<	3.2	50,000 a
Anthracene	<	156	23.1	<	<	<	4.8	
Fluoranthene	<	300	118	<	<	<	8.0	
Pyrene	18.5	498	151	27.3	32.8	<	8.3	100,000 a
Benzo(a)anthracene	<	176	53.9	<	<	<	33.6	10,000 a
Chrysene	<	208	66.1	<	<	<	33.6	
Benzo(b)fluoranthene	<	189	70.0	<	<	<	22.4	10,000 a
Benzo(k)fluoranthene	<	115	51.7	<	<	<	22.4	10,000 a
Benzo(a)pyrene	<	148	44.0	<	<	<	19.2	10,000 a
Indeno(1,2,3-cd)pyrene	<	183	54.4	<	<	<	24.0	10,000 a
Dibenzo(a,h)anthracene	<	25.3	<	<	<	<	19.2	10,000 a
Benzo(ghi)perylene	<	173	50.4	<	<	<	19.2	
BNA (including PAH repeats)								
Naphthalene	<	200	87.5	<	<	<	1.6	50,000 a
Acenaphylene	<	33.3	9.55	<	<	<	3.2	
Acenaphthene	<	83.2	11.6	<	<	<	3.2	

Table 5
SUMMARY OF COMPOUNDS DETECTED IN SOIL SAMPLES (ppb)

Sample	BHS6 (3.5m)**	BHS7 (2m)	BHS11 (3.5m)	MWN3B (5m)	MWN3A (17m)	Lab Blank	Detect. Limit	Conc. Limit
Field Classification	NC	TC	TC/VC	NC	NC			
Compound*								
Fluorene	<	388	20.0	<	<	<	3.2	
Phenanthrene	5.06	481	122	9.50	15.2	<	1.6	50,000 a
Anthracene	<	148	16.4	<	<	<	1.6	
Fluoranthene	<	268	100	<	<	<	1.6	
Pyrene	12.4	376	108	23.1	28.0	<	1.6	100,000 a
Benzo(a)anthracene	<	143	42.7	<	<	<	1.6	10,000 a
Chrysene	<	173	57.4	<	<	<	17.6	
Benzo(b)fluoranthene	<	149	60.6	<	<	<	3.2	10,000 a
Benzo(k)fluoranthene	<	123	58.3	<	<	<	1.6	10,000 a
Benzo(a)pyrene	<	129	38.0	<	<	<	1.6	10,000 a
Indeno(1,2,3-cd)pyrene	<	132	43.0	<	<	<	1.6	10,000 a
Dibenzo(ah)anthracene	<	30.8	<	<	<	<	1.6	10,000 a
Benzo(ghi)perylene	<	180	54.4	<	<	<	1.6	
2-Methylnaphthalene	<	1520	134	<	<	<	3.2	
1-Methylnaphthalene	<	693	105	<	<	<	3.2	
Biphenyl	<	139	16.4	<	<	<	3.2	
Benzybutylphthalate	28.6	69.7	30.9	15.9	50.4	<	3.2	
Di-n-butylphthalate	43.3	115	49.2	45.5	59.3	0.26	3.2	
Perylene	<	42.4	11.5	<	<	<	1.6	
Phenolics (Coal Tar Acids)								
o-cresol	<	<	<	<	<	<	8.0	

Table 5
SUMMARY OF COMPOUNDS DETECTED IN SOIL SAMPLES (ppb)

Sample	BHS6 (3.5m)**	BHS7 (2m)	BHS11 (3.5m)	MWN3B (5m)	MWN3A (17m)	Lab Blank	Detect. Limit	Conc. Limit
Field Classification	NC	TC	TC/VC	NC	NC			
Compound*								
m-cresol	<	<	<	<	<	<	8.0	
p-cresol	<	<	<	<	<	<	8.0	
2,6-Dimethyl phenol	<	<	<	<	<	<	8.0	
2,5-Dimethyl phenol	<	<	<	<	<	<	8.0	
2,4-Dimethyl phenol	<	<	<	<	<	<	8.0	
3,5-Dimethyl phenol	<	<	<	<	<	<	8.0	
2,3-Dimethyl phenol	<	<	<	<	<	<	8.0	
3,4-Dimethyl phenol	<	<	<	<	<	<	8.0	
Resorcinol	<	<	<	<	<	<	8.0	

*all concentrations in ppb
**depth below ground surface

Concentration Limits:
a - CCME (1989) Value C (Level at which contamination is significant)

Examination of air photographs, the onsite reconnaissance survey, and the drilling/soil sampling program did not locate any disposal areas onsite where contaminated soil, excavated from the former pond, was buried in the subsurface. However, information made available by the MOE subsequent to the field investigations suggested that the disposal area may have been located in the western part of the property (i.e. west or southwest of BH56, Figure 3), outside the area of the preliminary site investigation. Further field investigation was conducted and the results are described in an addendum to this report (Section 7).

In the area of MWN1, near the former tar pit location, contamination appeared at depth. Examination of the cross-section (Figure 6) shows that the contaminated soil is probably located very close to the bottom of the sand aquifer. Flowing sand conditions prevented the installation of deeper boreholes in this location, so the exact location of the interface between the sand aquifer and the underlying clayey sand unit could not be confirmed.

It is possible that dense liquid tar and related products have moved downward through the sand aquifer in the area of the former tar pit. There may be liquid tar pooling at the bottom of the aquifer in this location. This tar pool may have migrated horizontally a short distance by gravity flow along the base of the sand aquifer. This could explain why MWN1 encountered soil contamination only at depth.

Alternatively, it is possible that contamination in the area of the former tar pond is only present as dissolved, or aqueous-phase, contamination in the groundwater and contamination adsorbed on to the soil particles.

Two soil samples from MWN3, taken from 5 m and 17 m below ground surface, were submitted for chemical analysis. There was no significant difference in PAH or Phenolics content between the two samples (Table 5). These results indicate that, at this location, there is no variation in PAH and Phenolic contamination with depth.

4.3 GROUNDWATER

4.3.1 MUNICIPAL WELLS

Municipal Well #2 was sampled on August 16, 1990. The results of chemical analysis are given in Table 4. Parameters analyzed were PAHs, Phenolics, BTXE, and Base/Neutral/Acid Extractable Compounds (BNA) (see Appendix H).

Low concentrations (below applicable drinking water standards) of Phenol, Naphthalene, Benzybutylphthalate and Di-n-Butylphthalate were detected in the sample from Well #2. However, these compounds were also detected in the travel blank sample. The detection of these compounds does not conclusively indicate their presence in the groundwater taken from Well #2.

4.3.2 ONSITE MONITOR WELLS

Samples of groundwater from all wells except MWN3B and MWS3 were submitted for chemical analysis. The results are presented in Table 4, and can be summarized as follows:

MWN1A — Located in the area of the former tar pond, at a depth of about 18 m below ground surface. Groundwater at this location was contaminated with PAHs, Phenolics, and BTXE. Benzene was found at levels over the Canadian Maximum Acceptable Concentrations for drinking water (MAC). Toluene and xylenes exceeded Canadian Aesthetic Objectives for drinking water (AO). Total phenols exceeded MOE Maximum Desirable Concentration for drinking water (MDC). Naphthalene exceeds CCME guidelines A and B. In addition, water from this well had a strong chemical odour, and the water foamed as it came into contact with the atmosphere. Two weeks after well purging, foam was still present on the water surface in the well.

MWN1B — Located in the area of the former tar pond, at a depth of about 8 m below ground surface. Groundwater at this location contained detectable levels of xylene, PAHs, and Phenolics. Only naphthalene and total phenols were found in concentrations exceeding guidelines (CCME guideline A and MOE. MDC, respectively). Water from this well had a distinct odour, and the water foamed as it came into contact with the atmosphere.

MWN2A — Located in the central area of the site, south of the former oven house/acetate storage house, at a depth of about 18 m below surface. All measured parameters except total phenols were detected at concentrations below the applicable drinking water standards. Repeat analyses of phenol gave concentrations of 0.5 and 8 ppb. 8 ppb exceeds the Ontario MDC of 2 ppb for phenols. The poor repeatability of the analyses means there is considerable uncertainty in the phenol concentration at this location.

MWN2B — Located in the central area of the site, south of the former oven house/acetate storage house, at a depth of about 8 m below surface. All measured parameters except total phenols were detected at concentrations below the applicable drinking water standards. Total phenolics were found to exceed the MOE. MDC of 2 ppb.

MWN3A, MWS1, MWS2 — Water samples from these wells were uncontaminated. No significant levels of PAHs, Phenolics or BTXE were measured.

Groundwater in the area of the former tar pond was found to be contaminated. The areal extent of groundwater contamination appears to be quite limited since wells only 100 to 150 m away from MWN1 produce uncontaminated water. Nevertheless, it is important to note that high levels of contamination are present in the water supply aquifer, and this contamination is only 300 m from the municipal wells.

In the tar pond area, groundwater contamination appears to be more severe at depth in the aquifer. As was discussed in Section 4.2, this pattern of contamination at depth may be caused by the presence of pools of liquid tar existing at the base of the aquifer.

4.4 CHEMICAL CHARACTERIZATION OF WOOD TAR FOUND ONSITE

Wood tar was found onsite, both on the ground surface and on the lake bottom adjacent to the former plant property. Three samples of tar were collected and submitted for chemical analysis: tar from ground surface near MWN1, tar "crust" from the lake bottom, and liquid tar from the lake bottom. The results are presented in Appendix E and summarized in Table 6.

Tar samples were dark brown in colour, sticky, denser than water, and were viscous to solid. They had a very strong odour.

In general, the tar is characterized by high levels of PAHs, BTXE and certain other volatile organic chemicals, and phenolic compounds. The phenolic compounds, which are relatively water-soluble, appear to be leached out of the tar collected from the lake bottom.

The tar samples have high concentrations of some volatile organic chemicals (BTXE, methylene chloride, methyl ethyl ketone, and chloroform). These chemicals are found in concentrations of approximately 1000 to 30000 ppb. These compounds are common constituents of solvents and cleaning agents, which likely was their source.
The tar samples also contain high concentrations of PAHs. In the "fluid" tar collected from the lake bottom, PAHs are found in concentrations of approximately 1000 to 10000 ppb. These levels exceed the CCME Guideline B for soil samples (Appendix H). In the tar "crust" collected from the lake bottom, and in the tar from ground surface, PAHs are found in concentrations of approximately 2000 to 40000 ppb. These concentrations exceed the CCME criteria B and in many cases, the CCME criteria C for soil samples. This signifies that the tar samples have a high level of contamination (see Appendix H).

The tar sample collected from ground surface contained high levels of phenolic compounds. The concentration of phenolics ranged from about 50000 to 1350000 ppb (50 to 1350 ppm). The tar samples collected from the lake bottom had lower or non-detectable levels of phenolics. This is presumably due to dissolution of the relatively water-soluble phenolic compounds.

Table 6
SUMMARY OF COMPOUNDS DETECTED IN TAR SAMPLES (ppb)

Compounds	Tar on Ground Surface near MWN1	Tar on Lake Bottom near 2+40 (tar "crust")	Tar on Lake Bottom near 3+60 (fluid tar)	Lab. Blank	Detect. Limit *
VOCs					
Methylene Chloride	3360	N/A	3300	<	1.8
Methyl Ethyl Ketone	7260	N/A	4700	<	1.1
Chloroform	1620	N/A	1750	1.2	0.4
Benzene	3380	N/A	<	<	0.4
Toluene	25800	N/A	1060	<	0.7
m&p Xylene	28750	N/A	5130	<	0.6
o Xylene	22700	N/A	2880	<	0.4
Ethyl Benzene	17450	N/A	2100	<	2.6
Phenolics (Coal Tar Acids)					
Phenol	278000	<	<	N/A	8.0
o-Cresol	214000	<	<	N/A	8.0
m-Cresol	414000	<	<	N/A	8.0
p-Cresol	385000	<	<	N/A	8.0
2,5-Dimethyl phenol	75300	<	<	N/A	8.0
2,4-Dimethyl phenol	110000	<	<	N/A	8.0
3,5-Dimethyl phenol	45700	<	614	N/A	8.0
3,4-Dimethyl phenol	99100	<	855	N/A	8.0
Resorcinol	64600	<	<	N/A	8.0
PAHs					
Naphthalene	22300	40000	8840	<	24
Acenaphthylene	<	14300	1740	<	9.6
Acenaphthene	<	17200	2530	<	9.6

Table 6
SUMMARY OF COMPOUNDS DETECTED IN TAR SAMPLES (ppb)

Compounds	Tar on Ground Surface near MWN1	Tar on Lake Bottom near 2+40 (tar "crust")	Tar on Lake Bottom near 3+60 (fluid tar)	Lab. Blank	Detect. Limit *
Fluorene	34000	72200	8280	<	9.6
Phenanthrene	<	57000	<	<	3.2
Anthracene	<	27900	<	<	4.8
Fluoranthene	5870	17000	<	<	8
Pyrene	12000	115000	2020	<	8.3
Benzo(a)anthracene	<	95600	<	<	33.6
Chrysene	<	8080	<	<	33.6
Benzo(b)fluoranthene	<	<	<	<	22.4
Benzo(k)fluoranthene	<	<	<	<	22.4
Benzo(a)pyrene	<	<	<	<	19.2
Indeno(1,2,3-cd)pyrene	<	<	<	<	24
Dibenzo(ah)anthracene	<	<	<	<	19.2
Benzo(ghi)perylene	<	<	<	<	19.2
BNA (including PAH repeats)					
Naphthalene	26400	47200	7770	<	1.6
Acenaphthylene	<	14200	1910	<	3.2
Acenaphthene	<	24700	3570	<	3.2
Fluorene	45800	152000	13500	<	3.2
Phenanthrene	33600	82500	<	<	1.6
Anthracene	<	37500	<	<	1.6
Fluoranthene	10500	19000	<	<	1.6
Pyrene	12200	29000	1530	<	1.6
Benzo(a)anthracene	<	8000	<	<	1.6

Table 6
SUMMARY OF COMPOUNDS DETECTED IN TAR SAMPLES (ppb)

Compounds	Tar on Ground Surface near MWN1	Tar on Lake Bottom near 2+40 (tar "crust")	Tar on Lake Bottom near 3+60 (fluid tar)	Lab. Blank	Detect. Limit *
Chrysene	<	9000	<	<	17.6
Benzo(b)fluoranthene	<	<	<	<	3.2
Benzo(k)fluoranthene	<	<	<	<	1.6
Benzo(a)pyrene	<	<	<	<	1.6
Indeno(1,2,3-cd)pyrene	<	<	<	<	1.6
Dibenzo(ah)anthracene	<	<	<	<	1.6
Benzo(ghi)perylene	<	<	<	<	1.6
o-Cresol	1350000	<	<	<	1.6
m-Cresol	1300000	<	<	<	1.6
p-Cresol	1100000	<	<	<	1.6
2-methylnaphthalene	65100	186000	28800	<	3.2
1-methylnaphthalene	47800	13400	19500	<	3.2
Biphenyl	<	26800	37000	<	3.2
Benzybutylphthalate	44200	3700	<	<	3.2
Di-n-butylphthalate	<	<	<	0.26	3.2
Perylene	<	<	<	<	1.6

N/A: not analyzed
All concentration in ppb
* Detection Limits:
Tar on lake bottom near 2+40: 500 x those listed for VOC
Tar on lake bottom near 3+60: 500 x those listed for VOC
Tar on surface near MWN1: 144 x those lised for phenolics and PAH
Tar on lake bottom near 2+40: 112 x those listed for phenolics and PAH
Tar on lake bottom near 3+60: 21 x those lised for phenolics and PAH

Section 5
POTENTIAL IMPACTS OF CONTAMINATION

5.1 IDENTIFICATION OF EXPOSURE PATHWAYS

Three primary exposure pathways for release of the onsite contaminants have been identified. These are:

i) Groundwater migration to the municipal wells

ii) Direct contact with contaminated tars, soils, and lake sediments

iii) Aquatic biota uptake of contaminants from contaminated lake sediments

Each of these pathways is discussed separately in the following sections.

5.2 IMPACT ON MUNICIPAL WELLS

The presence of municipal water supply wells only 300 m from the site has created a concern that onsite groundwater contamination may eventually move towards these wells. From the available field data it is difficult to assess whether the site area presently lies within the capture zone of the municipal wells. The capture zone of a pumping well is defined as the entire recharge area of the well. At any point within the capture zone, groundwater will eventually flow towards the pumping well.

CH2M HILL ENGINEERING LTD. has used a groundwater computer model in order to help determine if groundwater contamination will eventually be drawn towards the municipal wells. Details of the model can be found in Appendix F.

The computer code selected for the model was "Flowpath", developed by Waterloo Hydrogeologic Software. Flowpath simulates a 2-dimensional aquifer in the plan view. The model calculates the distribution of water levels in the aquifer (hydraulic head), and the direction and velocity of groundwater flow in the aquifer. In addition, the model calculates the flow paths of groundwater "particles" placed anywhere within the aquifer.

The aquifer properties which are input into the model are: hydraulic conductivity, porosity, and aquifer thickness. Other input parameters include infiltration from the ground surface and pumping rates of wells.

The model simulation domain is shown in Figure 8. The edges of the aquifer were taken to be: Forest Lake on the northeast and east; the boundary of the bedrock valley on the south and the southwest; and an arbitrary boundary on the west, far from

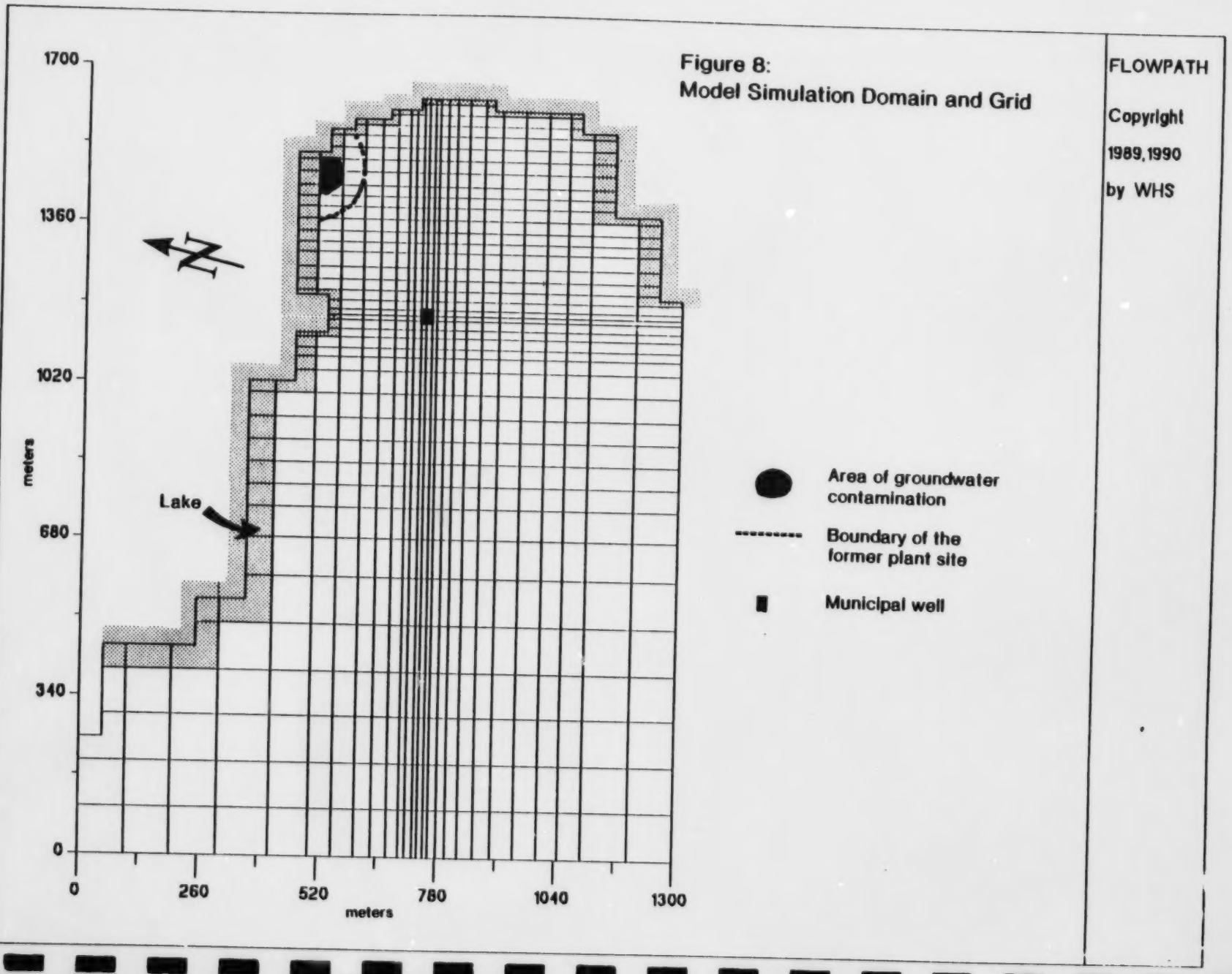

Figure 8:
Model Simulation Domain and Grid

FLOWPATH
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the site and pumping wells.

The steady-state groundwater flow regime calculated by the model is shown in Figure 9. There is regional groundwater flow in a northerly direction, ie. towards the lake. Superimposed on this regional flow pattern is the effect of the municipal well. A "drawdown cone" is evident around the well, where groundwater flows towards the well.

The 25 year and 50 year capture zones of the well are illustrated in Figures 10 and 11. The 25 year capture zone includes the area of the former plant site. In other words, groundwater from the boundary of the former plant site is calculated to reach the municipal wells in about 25 years. The 50 year capture zone includes the area where contaminated groundwater is known to exist (near the location of the former tar pit). The model calculates that groundwater from this area will reach the municipal wells in approximately 50 years.

The results of the model indicate that, under current conditions, the site area is likely to lie within the capture zone of the municipal wells. However, the model indicates a travel time of 25 to 50 years for groundwater now underneath the site to travel to the municipal wells. The municipal wells have presently been in operation for about 10 years. Model simulations indicate that groundwater underneath the former tar pit area would only travel 50 to 200 m towards the municipal wells in the first 10 years of pumping. This is not inconsistent with the observed limited extent of groundwater contamination underneath the site.

Contaminants in groundwater may not travel at the same velocity as the groundwater itself. The transport of a contaminant may be slowed, or "retarded", by processes such as adsorption to soil, chemical transformations, or biodegradation. The transport rate of a contaminant relative to the groundwater velocity is expressed by **R**, the retardation factor.

Typically, for organic compounds such as PAHs, adsorption to soil is the dominant mechanism affecting the speed at which the compound is transported in groundwater. In this case, **R** can be estimated as follows:

$$\mathbf{R} = 1 + (d/n)K_d$$

and $$K_d = f_{oc} * K_{oc}$$

where

- K_d is the distribution coefficient
- f_{oc} is the fraction of organic carbon in the soil. Analyses of this parameter in two soil samples are presented in Appendix E.
- K_{oc} is the organic carbon partitioning coefficient, a parameter which has been measured for many organic compounds.
- d is the bulk density of the soil
- n is the porosity of the soil

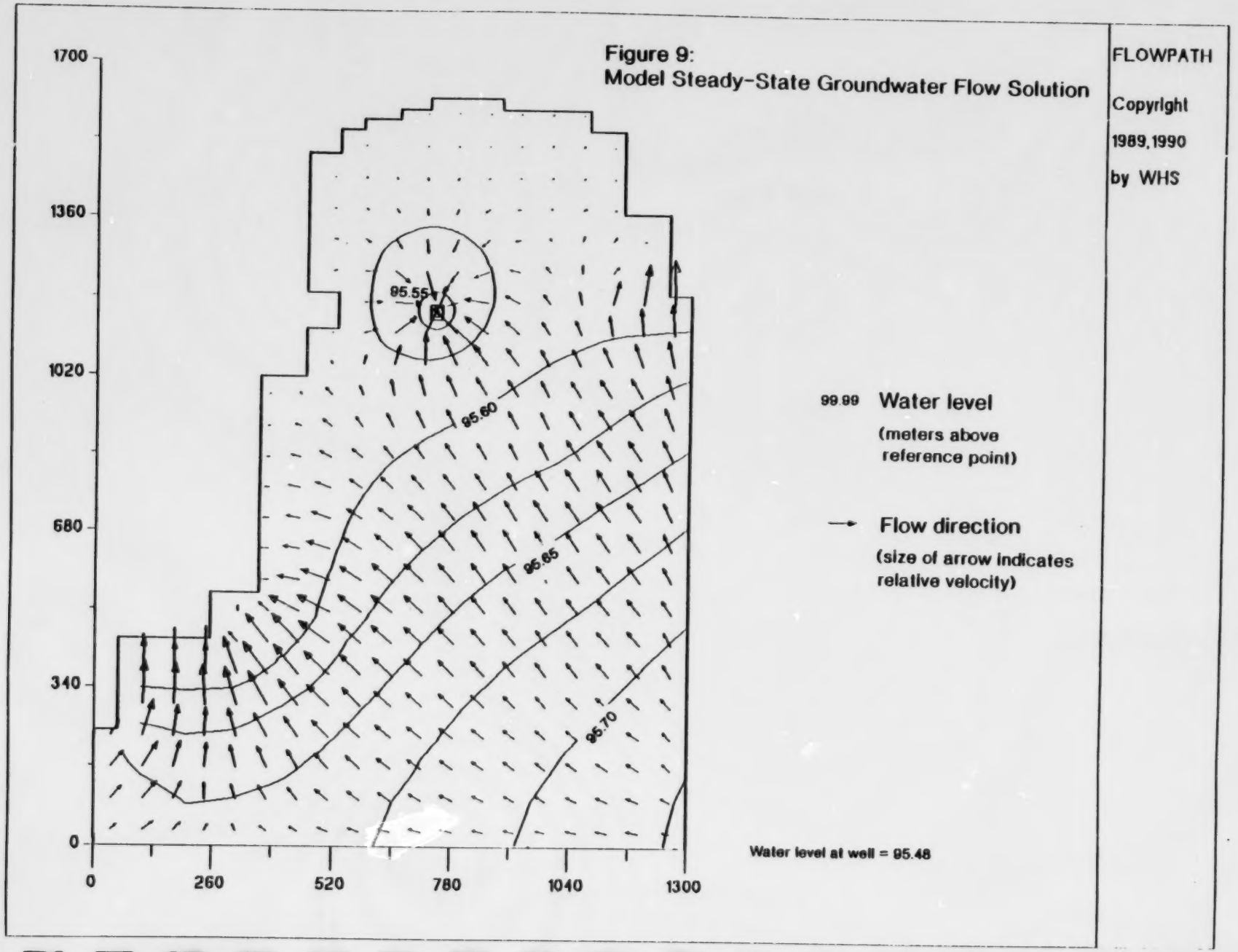
Figure 9:
Model Steady-State Groundwater Flow Solution
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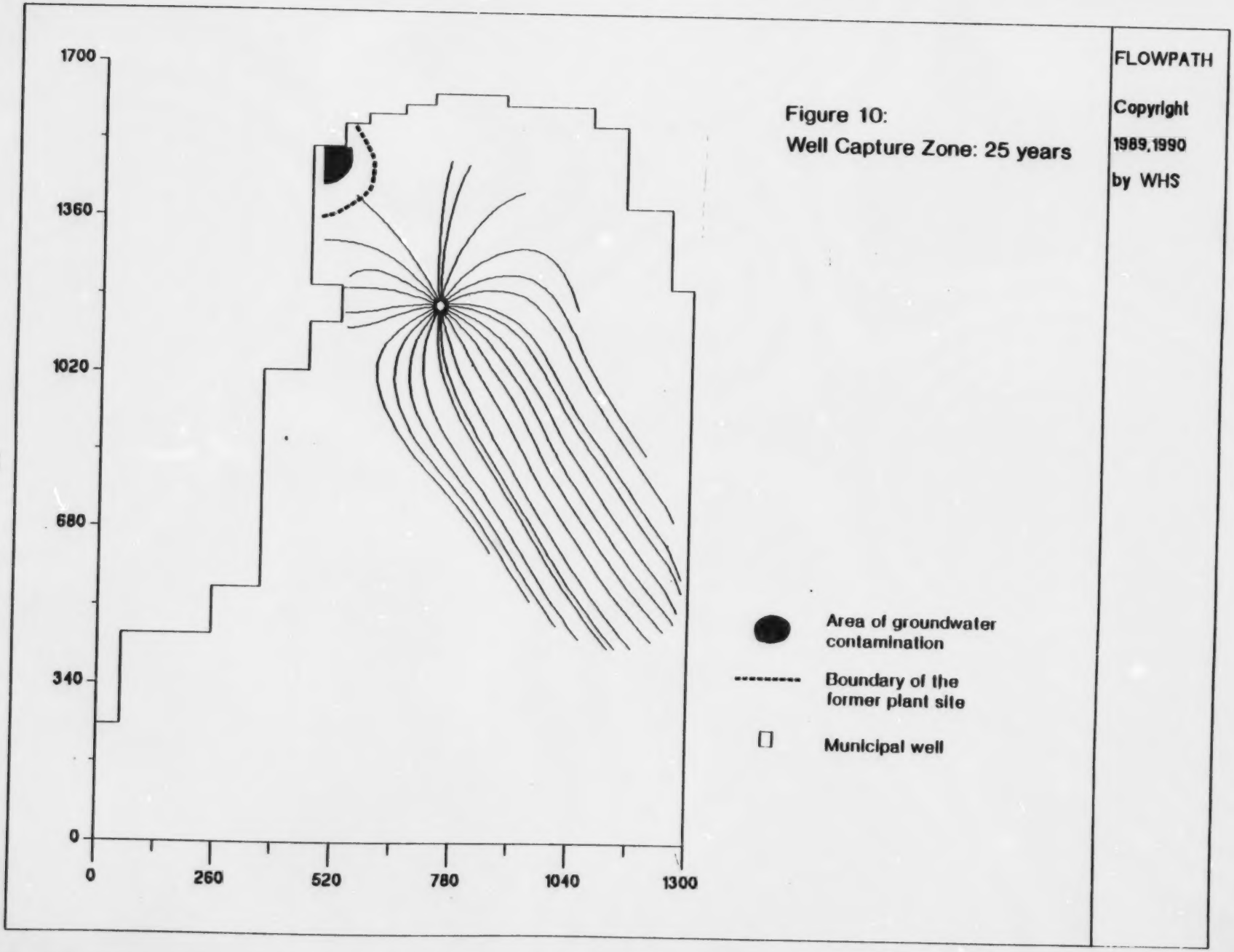
1700
1360
1020
680
340
0
0
260
520
780
1040
1300
95.55
95.60
95.65
95.70
99.99 Water level
(meters above reference point)
Flow direction
(size of arrow indicates relative velocity)
Water level at well = 95.48


1700
1360
1020
680
340
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780
1040
1300
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Figure 10:
Well Capture Zone: 25 years
Area of groundwater contamination
Boundary of the former plant site
Municipal well

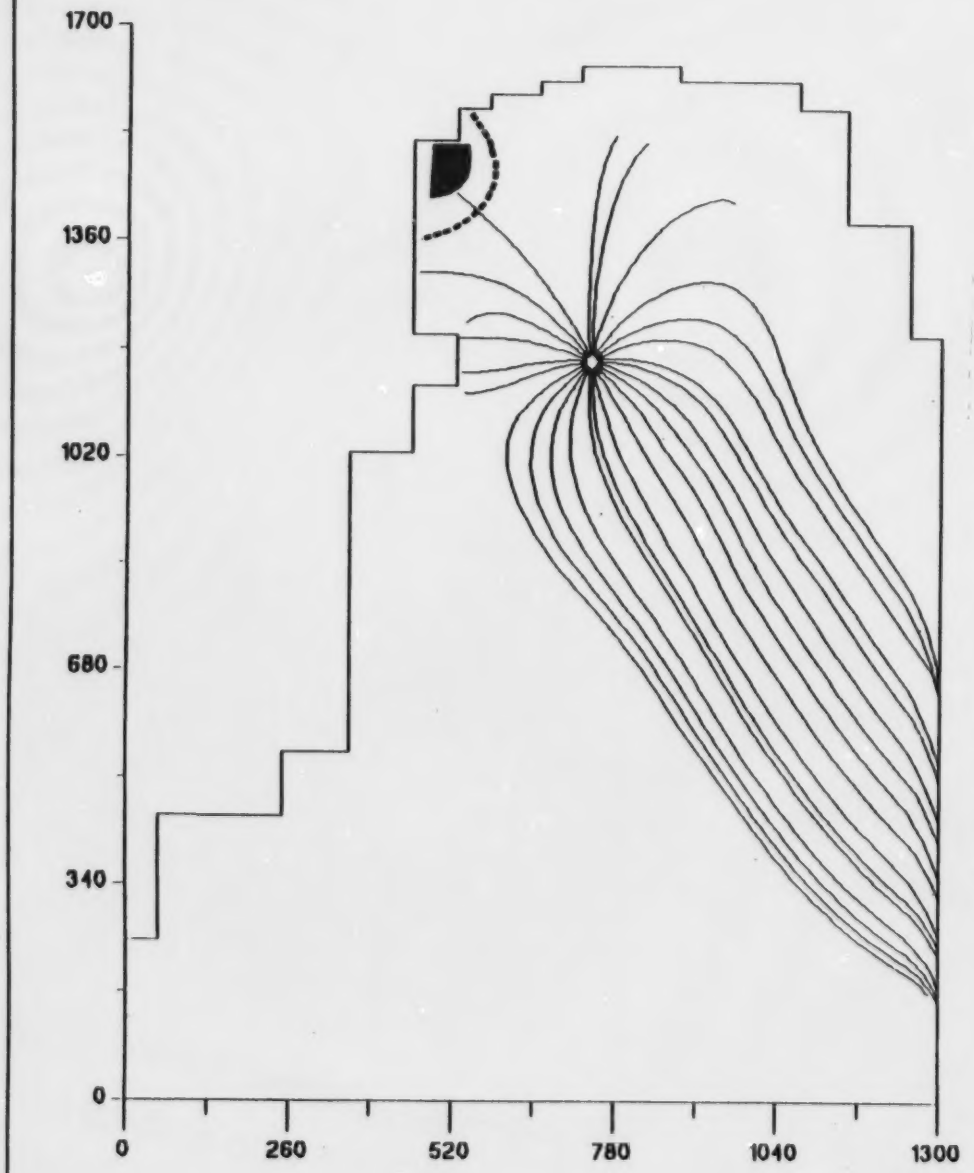

Figure 11:
Well Capture Zone: 50 years

Area of groundwater contamination

Boundary of the former plant site

Municipal well

FLOWPATH

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Retardation factors for several of the organic contaminants found in waste at the site have been calculated, and are presented in Table 7.

Table 7
CALCULATED RETARDATION FACTORS FOR SELECTED ORGANIC COMPOUNDS

Compound	log K_{oc}	K_d	R
Phenol	1.23 - 1.43	.006	1.03
Benzene	1.69 - 2.00	.021	1.10
Naphthalene	2.74 - 3.52	0.40	3.0
Benzo(a) pyrene	5.60 - 6.29	264	1321

NOTES:

K_{oc} = Organic carbon partitioning coefficient. Values from Montgomery and Welkom, (1990).
K_d = Distribution coefficient
R = Retardation factor

- porosity assumed to be 0.3
- bulk density assumed to be 1.5
- fraction of organic carbon = .0003 (Appendix E)

Phenol has the lowest retardation factor, at a value of 1.03. This value indicates that phenol will travel at about the same velocity as the groundwater. Benzo(a)pyrene has the highest retardation factor, at a value of 1321. This indicates that benzo(a)pyrene will travel roughly 1300 times slower than the groundwater.

Examination of the retardation factors shows that phenol will probably travel at the same speed as the groundwater, and will likely be transported towards the pumping wells at a greater effective velocity than other, more retarded contaminants. For this reason, all discussion of contaminant transport assumes a transport velocity equal to the speed of groundwater flow, such as would be the case for phenol. It is important to note that contaminated groundwater reaching the municipal wells will be diluted by the uncontaminated groundwater drawn from other parts of the capture zone. For example, the arrival of phenol at the municipal wells will not necessarily correspond to unacceptable levels of phenol in the municipal water supply. It is difficult to estimate if or when unacceptable levels of contamination will occur at the municipal wells. Therefore, the effect of dilution of contaminants at the well has not been considered in the previous discussions. Also, these estimates of contaminant transport velocities do not include the mitigating effect of natural biodegradation of the contaminants in the subsurface. This may result in conservative (i.e. underestimated) predictions regarding the length of time for contaminants to impact the water supply wells.

In summary, groundwater contamination found in the water supply aquifer under the former plant site area is likely to eventually degrade the water quality of the municipal wells. Phenols and other compounds are present in the contaminated groundwater in concentrations exceeding drinking water criteria. Mobil contaminants, such as phenol, are likely to migrate to the municipal wells in 25 to 50 years. Other, less mobile contaminants are expected to arrive at the wells following phenol arrival.

5.3 CONTACT WITH CONTAMINATED SOILS AND SEDIMENTS

A high potential exists for direct human contact with the wood distillation/charcoal plant wastes at the site. There are surface exposures of tar over the central area of the site and tar present on the lake bottom adjacent to the site (Figure 7). There is unrestricted access to the site and to the lake shore via tracks coming from Ottawa Avenue. There is evidence onsite that the area is occasionally used for recreation (camping, motor-bike trails, raspberry picking). Forest Lake is occasionally used for recreational purposes such as canoeing. It should also be noted that the presence of old building foundations and piles of rubble from former buildings may pose a hazard to people travelling over the site area.

Access to the site presents a risk to human health by direct contact with hazardous materials or physical hazards.

5.4 AQUATIC BIOTA UPTAKE OF CONTAMINANTS FROM LAKE SEDIMENTS

The sediments on the lake bottom adjacent to the site are slightly to highly contaminated with PAHs. Chronic exposures to low concentrations of PAHs in water, food, or sediments may produce effects such as: reduced survival, behavioral changes, impaired reproduction, or cancer induction in aquatic organisms (Environmental Research and Technology, 1984).

Concern has been expressed that PAHs may bio-accumulate to toxic levels in aquatic biota. When the aquatic biota enter the food chain this has significance to both human and animal health (NRC, 1983).

Little quantitative data is available on the impact of PAHs on aquatic biota, and there are few regulatory guidelines for PAH levels in lake sediments. However, given the high concentrations of PAHs associated with some of the lake sediment samples, impairment to the aquatic ecosystem in Forest Lake is probable.

Section 6
DISCUSSION OF GENERAL REMEDIAL ACTION ALTERNATIVES

The overall objective of any remedial action is to mitigate health or environmental impacts resulting from the presence of wastes originating from the plant site. Cost-effectiveness of the remedial action is an important factor.

In Section 5 of this report, three primary exposure pathways for release of contaminants were identified. Typical remedial alternatives for each of these cases are discussed in the following sections.

6.1 REMEDIATION OF CONTAMINATED GROUNDWATER

A number of remedial measures to address contaminated groundwater were considered which include the following:

i) no action

ii) monitoring of groundwater quality in wells located between the municipal wells and the former tar pit area. Further action to be taken if and when contamination approaches the municipal wells

iii) "pump and treat" with onsite treatment of groundwater

iv) "pump and treat" with offsite treatment of groundwater

v) installation of in situ hydraulic barriers around contaminated groundwater

The "no action" option is not acceptable as human health remains at risk.

Option (ii) is acceptable. This option should include installing new well nests to increase the coverage of the monitor well network. Sampling and chemical analysis of groundwater from the monitor wells should be performed semi-annually.

This alternative will be cost-effective in the short term. However, if contamination is found to be moving toward the municipal wells, the remaining remedial alternatives must be re-evaluated and the costs of remediation may increase greatly. Under present conditions the contaminated groundwater onsite is not expected to impact the municipal wells for a significant length of time, on the order of 25 years. However, any change in groundwater flow patterns, such as increases in pumping rates, could result in contamination reaching the municipal wells in a shorter period of time. Changes in groundwater flow patterns could also result from re-development of the site.

Options (iii) and (iv) are acceptable. However, these options are likely to be relatively expensive. This level of effort may not be necessary as contaminated groundwater does not appear to currently be moving offsite at a significant rate.

Option (v) is not acceptable at this time. Conventional hydraulic barriers, such as sheet piling or injected grout curtains, have not been proven to be effective hydraulic barriers in high permeability materials such as the sand aquifer below the study area. Other conventional methods, such as slurry walls, are likely to cause a significant disruption of onsite groundwater flow during installation procedures. This may lead to offsite migration of groundwater contamination. Given the uncertainties associated with hydraulic barrier technology at this time, this option may not eliminate risk to human health and, therefore, is unacceptable. New technologies in hydraulic containment may be available in the future. If a re-evaluation of groundwater remedial strategies is done in the future, option (v) should also be re-evaluated.

6.2 REMEDIATION OF CONTAMINATED SOIL

According to CCME guidelines (Appendix H), remedial action need only be considered for the tar-contaminated areas on the ground surface. The remedial measures considered include the following:

i) no action

ii) cover exposed tar-contaminated areas with soil and grass

iii) excavation and burial of tar-contaminated soil onsite

iv) excavation and removal of tar-contaminated soil

v) excavation and onsite treatment of tar-contaminated soil

The "no action" option is not acceptable as human health remains at risk.

Option (ii) and (iii) are acceptable. This option would prevent direct contact with contaminated soil and tar, but will likely cause continued or further contamination of groundwater. This option must be considered in conjunction with an appropriate groundwater remediation scheme. In the case of onsite burial, pits lined with clay and/or synthetic liners may be appropriate. These liners may decrease the amount of groundwater contamination resulting from waste burial. However, these liners are unlikely to eliminate further groundwater contamination.

Option (iv) is acceptable. Although the amount of contaminated soil and tar is relatively small, this option is likely to be expensive. Contaminated materials must be shipped to a treatment disposal facility. Correct protocols must be observed for the transport, treatment and disposal of hazardous waste.

Option (v) is acceptable. Several methods of onsite treatment may be appropriate, including bio-remediation (i.e.land farming) or portable slurry bio-reactors. The waste residue may be disposed onsite or in a municipal waste facility, depending on the degree of success of the treatment. The cost-effectiveness of this option will vary with the treatment technology selected. The scope of this report does not include an investigation of onsite treatment technologies. This option must include a feasibility study to select an appropriate technology.

6.3 REMEDIATION OF CONTAMINATED LAKE SEDIMENTS

A significant amount of tar is present on the lake bottom near shore. The sediments on the lake bottom adjacent to the site are highly contaminated with PAHs. Regulatory guidelines (outlined in Section 4.1.1) indicate that remedial action may be required for lake sediments in the immediate area of visual tar contamination on the lake bottom. The remedial actions which were considered included:

i) no action

ii) excavation of contaminated material and burial onsite

iii) excavation, removal and disposal of contaminated material

iv) excavation and onsite treatment of contaminated material

The "no action" alternative (i) is not acceptable. Human health remains at risk because there is a significant possibility that persons using Forest Lake for recreational purposes may come into contact with tar on the lake bottom. As well, there may be adverse impacts on aquatic biota.

Option (ii) is acceptable. This option would prevent direct contact with contaminated sediments and tar, but will likely cause further contamination of groundwater. Burial in pits lined with clay or synthetic liners may be appropriate, as discussed in Section 6.2.

Option (iii) is acceptable. However, this option is likely to be expensive. Excavation of materials from the lake is possible as the water depth over the contaminated area is generally less than 1 m. Excavated materials will likely need to be de-watered to some extent before storage and/or transport can occur. Contaminated materials must be shipped to a treatment facility. Correct protocols must be observed for the transport and treatment of hazardous waste.

Option (iv) is acceptable. Possible methods are discussed in Section 6.2. Dewatering of excavated material may not be necessary before treatment, depending on the method of treatment.

Section 7
ADDENDUM: INVESTIGATION OF BURIED TAR POND WASTE

7.1 FIELD INVESTIGATION AND RESULTS

In April 1991, a second field investigation was conducted in the southwest portion of the former South River Wood Distillation/Charcoal plant site, to confirm the location of disposal trenches containing buried tar pond waste.

During a site reconnaissance visit, representatives of CH2M HILL ENGINEERING LTD., and the MOE North Bay office, met with the contractor responsible for the original excavation of the disposal trenches. A shallow test pit program was conducted to confirm the location and nature of the buried tar pond waste.

The disposal trenches were confirmed to be approximately 60 metres northeast of the South River municipal wells. The tar pond waste was buried in 3 parallel trenches, each approximately 6 metres wide and 1 metre deep. The lengths of the trenches ranged from 37 metres to 77 metres. The locations of the trenches are marked on Figures 3 and 7.

The disposal trenches had been excavated into the sand deposit which underlies the entire site. Waste was buried in the unsaturated zone, with the bottom of the disposal trenches located about 2 to 4 metres above the water table.

The tar pond waste had been mixed with sand prior to burial. The buried waste had a distinct odour, and consisted of damp, black-stained sand containing traces of brick fragments, metal pipe, and other construction wastes. Sand immediately underneath the buried waste was not visibly contaminated but had a distinct wood-tar odour. Samples of both the buried waste and of the underlying sand were taken by CH2M HILL.

Sample locations are shown on Figure 3 and samples are described below:

Sample	Description
A	Trench 1; depth 1 m; black-stained sand, strong odour
B	Trench 1; depth 2 m; brown sand, moderate tar odour (taken from below the buried waste)
C	Trench 3; depth 0.5 m; black, hard tar waste, very strong odour
D	Trench 2; depth 1.0 m; black, hard tar waste, very strong odour
E	Trench 2; depth 2.0 m; black sand, tar odour

Samples A, B, D and E were analyzed for PAHs and phenolic compounds (Appendix J) and the results are summarized in Table 8. Sample A, from within trench 1, contained low levels of PAHs at concentrations exceeding CCME guideline A but far below guideline C. Sample B, from below trench 1, shows no significant PAH or phenolic compound contamination.

Samples D and E, from within trench 2, contain significant levels of PAHs and phenolic compounds. In sample E, two parameters approach or exceed CCME guideline C: phenanthrene and naphthalene.

7.2 POTENTIAL IMPACTS OF BURIED WASTE

The primary exposure pathway for release of contaminants from the disposal trenches is through groundwater migration to the municipal wells. However, presently there is no detectable contamination in groundwater samples from the municipal wells.

It is likely that infiltrating precipitation is leaching soluble contaminants from the buried waste and transporting this aqueous-phase contamination to the shallow groundwater. The plume of contaminated groundwater underlying the trenches is likely very limited in vertical extent, i.e. the plume probably extends less than 1 metre vertically downward from the watertable.

The results of the groundwater model (Section 5.2) indicate that, under current conditions, the disposal trenches lie within the two-year capture zone of the municipal wells. However, no contamination had been detected in groundwater samples from the municipal wells. This is true even for relatively mobile contaminants such as phenol and benzene (see Table 4). The most probable explanations for the lack of detectable contamination in the municipal wells are (i) aerobic biodegredation of groundwater contamination prior to reaching the municipal wells, or (ii) dilution of groundwater contamination at the municipal wells. The installation of a groundwater monitor well located between the municipal wells and the disposal trenches (as shown on Figure 7) will confirm the nature of the groundwater quality in the area of the buried tar pond wastes.

Table 8
SUMMARY OF COMPOUNDS DETECTED IN SOIL SAMPLES from Buried Tar Pond Waste (ppb)

Sample	A Trench 1-1 m	B Trench 1-2 m	D Trench 2-1 m	E Trench 2-2 m	Lab Blank	Detect. Limit	Conc. Limit
Compound*							
PAHs							
Naphthalene	417	<	7134	45900	<	40	50,000 a
Acenaphthylene	<	<	<	<	<	80	
Acenaphthene	<	<	<	<	<	80	
Fluorene	<	<	4020	18200	<	80	
Phenanthrene	400	<	28400	85200	<	40	50,000 a
Anthracene	414	<	13000	49000	<	40	
Fluoranthene	141	<	4840	4670	<	40	
Pyrene	274	<	8130	1220	<	40	100,000 a
Benzo(a)anthracene	67.6	<	1990	5420	<	40	10,000 a
Chrysene	<	<	1750	5060	<	440	
Benzo(b)fluoranthene	<	<	2230	<	<	80	10,000 a
Benzo(k)fluoranthene	<	<	**	<	<	40	10,000 a
Benzo(a)pyrene	<	<	1340	<	<	40	10,000 a
Indeno(1,2,3-cd)pyrene	<	<	<	<	<	40	10,000 a
Dibenzo(a,h)anthracene	<	<	<	<	<	40	10,000 a
Benzo(ghi)perylene	90.0	<	<	<	<	40	
2-Methylnaphthalene	1210	<	15100	90900		80	
1-Methylnaphthalene	1140	<	10900	55500	<	80	
Phenolics							
Phenol	<	<	<	61500	<	240	
o-cresol	<	<	<	<	<	40	
m-cresol	<	<	<	8800	<	40	
p-cresol	<	<	<	9010	<	40	
2-Chlorophenol	<	<	<	<	<	120	
Biphenyl	<	<	785	10400	<	80	
2,4-Dimethyl phenol	<	<	<	<	<	320	

*all concentrations in ppb
**Benzo(b) and (k) fluoranthene co-eluted, therefore result is reported as a total

Concentration Limits:
a - CCME (1989) Value C (Level at which contamination is significant)

Section 8
CONCLUSIONS

The conclusions of this report are based on the geological and hydrogeological characterizations discussed previously. Other conditions between and beyond the areas of the investigation, or at times other than during the investigation, may differ from those encountered. This may become apparent during future investigations, at which time the interpretations and recommendations made in this report may be re-evaluated.

The conclusions of this report are:

Tar contamination exists on ground surface in the immediate area of the former wood distillation/charcoal plant buildings.

Tar contamination exists on the bottom of Forest Lake in the near-shore area adjacent to the site. Lake sediments in this area are contaminated with high levels of PAHs.

No significant contamination of the lake water was detected. No parameter was detected at concentrations exceeding drinking water criteria.

No PAH, phenolic, or BTXE contamination was detected in a water sample from the South River Municipal Well #2.

Groundwater contaminated with high levels of PAHs, BTXE, and phenolic compounds is present under the former tar pit area in the north-central area of the site. This contamination is not laterally extensive as groundwater samples taken less than 100 m away are not contaminated.

In the central area of the site, soil contamination in the subsurface appears to be limited to the areas of the former tar pit, and the oven house/holding tank house buildings. In these areas, evidence of contamination in the subsurface was limited to strong odours. None of the boreholes onsite intersected soil which contained free-phase oil or tar.

Soil and groundwater contamination at a depth of 20 m below ground surface in the area of the former tar ponds suggests that there may be pools of liquid tar existing at the base of the aquifer in this location.

No significant vertical or horizontal hydraulic gradients were measured in the groundwater underneath the site. Under these conditions, only slow groundwater movement is occurring across the site. The low horizontal hydraulic gradients make it difficult to determine the direction of groundwater flow underneath the site.

Buried tar pond waste was located in the southwest area of the property, about 60 metres from the South River municipal wells. Tar contaminated sand, placed in three disposal trenches, was buried in the unsaturated zone above the watertable.

Three primary exposure pathways for release of the onsite contaminants have been identified. These are: groundwater migration to the municipal wells, direct contact with contaminated tars, soils, and lake sediments, and aquatic biota uptake of contaminants from lake sediments. Typical remedial alternatives have been reviewed for each pathway.

Section 9
RECOMMENDATIONS

Recommendations for further investigations, and preliminary recommendations for remedial action are outlined in this section.

Recommendations for further investigation are outlined as follows:

- The results of the preliminary lake sediment survey show that Forest Lake sediments are significantly contaminated with wood tar. According to the draft Ontario Provincial Sediment Quality Guidelines, (SQG), further testing is required to define the environmental impact of this contamination. This should include an additional lake sediment sampling program, with samples submitted for analysis of total PAHs, organic carbon (TOC) and for bioassay (lethality) tests as outlined in the SQG.

  The extent of lake sediment contamination must also be further defined in order to facilitate remedial action. A more extensive diving inspection is required to map the horizontal and vertical (eg. sediment depth) extent of tar contamination. The diving inspection should follow a series of transect lines, perpendicular to the shoreline and extending outward into the lake. The inspection should cover the entire lake front area of the property and extend southeast to the Ottawa Avenue bridge.

- As a result of information made available subsequent to the original field investigation, buried tar pond wastes were discovered in a location 60 metres from the South River municipal wells. However, samples of groundwater from the municipal wells contained no detectable tar contamination. The installation and monitoring of one new shallow monitor well is recommended to monitor groundwater quality in the area near the buried waste. The proposed location of the new well between the buried waste and the municipal wells, is shown on Figure 7.

Preliminary recommendations for remedial action are outlined as follows:

- Restricted access to the former plant property is recommended in order to minimize direct contact with contaminated soil or physical hazards. This may be accomplished by installing fences or signs.

- Implementation of a groundwater monitoring program is also recommended. This should include installation of two new well nests, located to the west and to the southeast of MWN3 and one new shallow well near the disposal trenches. The locations of the proposed new wells are shown in Figure 7. The concentration of phenol and BTXE in MWN1, MWN2,

MWN3, the two new well nests, and the new shallow well should be regularly monitored.

- The preferred remedial action alternative to mitigate the impact of tar-contaminated material at ground surface is excavation and disposal offsite. Remedial action should be deferred, and re-evaluated after the detailed lake sediment study.

- The level of remedial action required to mitigate the impact of tar contaminated lake sediments will be defined by the detailed lake sediment survey and bioassay testing program outlined above.

- Site decommissioning, according to the Ontario MOE decommissioning guidelines (MOE, 1989), should be undertaken before any development of this property proceeds.

Section 10
REFERENCES

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Appendix A

FIELD INVESTIGATIONS

Appendix A

FIELD INVESTIGATION

A.1 SITE MAPPING

A site map was prepared by the pace and compass method. A 15 m grid was laid out over the central area of the site. Boreholes, monitor wells, building foundations, and other surface features were mapped during a walk survey. Small-scale air photographs were later used to complete the site map.

A.2 DRILLING/SOIL SAMPLING INVESTIGATION

The subsurface drilling investigation was undertaken between August 7, 1990 and August 20, 1990. A total of 19 boreholes were completed. Eleven shallow boreholes were drilled to the water table, between 4 and 5 metres below ground surface. Three boreholes were drilled to a depth of 9 metres below ground surface and were subsequently completed as shallow monitor wells. Three pairs of shallow and deep boreholes (9 and 19 metres below ground surface respectively) were drilled and subsequently completed as nests of shallow and deep monitor wells.

A track-mounted B-57 drill rig with hollow-stem augers was used to advance and sample borehole locations (Figure 3). Drilling procedures were complicated by sand flowing into the hollow stem of the augers. During drilling, this problem was minimized by filling the augers with water in order to force sand out the bottom of the augers.

Soil samples were obtained from borehole BH1 using a continuous sampler. All other borehole samples were obtained using a split-spoon sampler, which was more suitable to the "flowing sand" conditions. Split-spoon samples were taken at intervals of 0.76 m (2.5 ft.). Borehole soil samples were logged in the field, and placed in either plastic bags or glass jars. The samples were classified based on physical examination in the field as follows:

NC - No evidence of contamination by wood tar or related products

TC - Trace contamination by wood tar or related products based on colour

VC - Visual contamination with wood tar or related product

Field personnel placed selected soil samples into glass containers, which were stored in refrigerated coolers prior to submission to CANVIRO Analytical Laboratories Ltd. (CALL). Samples were selected to include one each of soils classified as NC, TC, and VC. Soil samples were analyzed for polycyclic aromatic hydrocarbons (PAHs) and phenolic compounds.

Between borehole locations, the augers and samplers were cleaned with water from nearby Forest Lake. Wash water was discharged to the ground surface on the site.

Boreholes not completed as monitoring wells were immediately backfilled using the excavated soil.

A.3 MONITOR WELL INSTALLATION

Monitor wells were installed in nine of the boreholes. The monitor wells included three shallow wells (MWS1, MWS2, MWS3) and three well nests each consisting of one shallow and one deep well (MWN1A, MWN1B, MWN2A, MWN2B, MWN3A, MWN3B). Locations of the wells are shown on Figure 3. Construction details of each well are given in the borehole logs, Appendix C.

Wells were constructed of 5 cm (2 inch) inside diameter, flush-threaded, schedule 40 PVC. Well screens were composed of machine slotted PVC. The well materials were cleaned by the manufacturer and delivered to the site in sealed plastic bags to prevent contamination in transit.

After auguring to the required depth, the well screen and riser pipe were installed through the hollow axis of the augers. Where flowing sand conditions existed, water was forced down the well screen and pipe during installation. The augers were pulled from the borehole and the native sand was allowed to collapse around the well screen and riser pipe. In most cases, bentonite seals were placed around the riser pipe several metres above the well screen, and also placed at ground surface. The riser pipes were protected at surface by casings of 10 cm (4 inch) ABS pipe and locking caps.

A.4 WELL DEVELOPMENT AND GROUNDWATER SAMPLING

Each monitoring well was developed in order to: (1) remove the fine material from the sand pack and develop a good filter area around the well screen; (2) remove water and sediment introduced into the well by the drilling operations; (3) ensure that representative groundwater samples could be obtained. Initial well development was done using a gasoline-powered centrifugal pump, which removed in excess of ten well volumes of water from each well. A well volume is the volume of water contained in the well screen, stand pipe, and the sand pack or disturbed area around the well. The monitoring wells were further developed by surging and purging the water in the wells using dedicated well samplers (Waterra pumps).

After well development, groundwater samples were collected using dedicated well sampling devices. All monitoring wells except MWS3 and MWN3B were sampled. The groundwater samples were collected directly into the appropriate sample containers provided by the laboratory, and clearly identified as to well location, well number, date and time, analyses required, and sampler signature. During sampling the pH, conduc-

tivity, and temperature of the groundwater was measured and recorded. All groundwater samples were placed in refrigerated storage onsite immediately after sampling, and were kept refrigerated during transport to the laboratory. Groundwater samples were analyzed for polycyclic aromatic hydrocarbons (PAHs), benzene, toluene, xylene, and ethyl benzene (BTXE), and phenolic compounds.

A.5 HYDRAULIC CONDUCTIVITY TESTING

Following groundwater sampling, hydraulic response or "bail" tests were performed on all monitor wells. The bail test consisted of removing a volume of groundwater from the well using a PVC bailer. A down-hole pressure transducer and automatic data logger recorded the water level response during the test. At many of the monitor well locations, no significant water level response was recorded during bail testing. This was presumably due to very large values of hydraulic conductivity of the subsurface materials at those locations.

Three borehole samples, chosen to represent the range of subsurface material encountered during drilling, were submitted for grain size analyses. The grain size analyses also provide an estimate of hydraulic conductivity.

A.6 WATER LEVEL MONITORING

All onsite monitor wells, as well as the South River municipal wells, were surveyed to determine a reference elevation for water level measurements. The water surface of Forest Lake was also included in the elevation survey. The survey was not tied-in to a geodetic benchmark, therefore a reference elevation of 100 m was assumed for the floor of the South River municipal well #1 pump house.

Water levels in all monitor wells were measured on August 17, 1990, August 20, 1990, and August 30, 1990.

A.7 DIVING INSPECTION AND LAKE SEDIMENT SAMPLING

Aquatic Sciences Incorporated performed a diving inspection in Forest Lake on August 13, 1990. Visual inspection of the lake bottom was carried out along a transect approximately 10 m out from shore. The inspection extended to a minimum of 3 m on either side of the transect line. The diver collected sediment samples at intervals of approximately 20 m along the transect line. Observations were reported over a two-way radio and were recorded by personnel on shore. Samples were collected directly into clean glass jars. At one location, a Shelby tube sampler was pushed by hand into the lake bottom to collect a shallow core of sediment. Recovery of sediment was extremely poor and this sampling method was not repeated.

The extent of tar contamination on the lake bottom was delineated during the visual inspection. The diver collected several samples of tar from the lake bottom. To minimize the amount of tar removed from the site, the interval between sampling locations was increased in the area where tar covered the lake bottom.

All lake sediment samples were examined in the field and classified as NC, TC, or VC, using the same classification criteria as for the borehole soil samples. A representative sample of each of the classified groups was selected for analysis including one contingency sample. The lake sediment samples were analyzed for PAHs and phenolic compounds.

A.8 COLLECTION OF SURFACE WATER SAMPLES

Two surface water samples were collected from Forest Lake adjacent to the study site. Each sample was collected in a different location from approximately .2 to .3 m below the lake water surface. Both locations were approximately 3 m out from shore, where the total water depth was .6 to .8 m. Sampling locations are shown on Figure 3.

Surface water samples were collected directly into the appropriate sample containers provided by the laboratory and clearly identified as to sampling location, date and time, analyses required, and sampler signature. During sampling the temperature, pH, and conductivity of the lake water was measured and recorded. Samples were placed in refrigerated storage onsite immediately after sampling and were kept refrigerated during transport to the laboratory. The lake water samples were analyzed for PAHs and phenolics.

A.9 COLLECTION OF TAR SAMPLES

Tar samples were collected both from ground surface onsite and from lake bottom surface in Forest Lake. Samples were collected directly into precleaned glass containers, which were tightly sealed, enclosed in two plastic bags, and kept isolated from water and soil samples to prevent cross-contamination. Tar samples were analyzed for PAHs, BTXE, and phenolics.

Appendix B

METHODS OF LABORATORY ANALYSIS AND QA/QC METHODS

B.1 SUMMARY OF LABORATORY ANALYTICAL METHODS

All analytical methods for PAH, Phenolic compounds (coal tar acids), BTXE, and Base Neutral Acid Extractable compounds (BNA) consisted of high resolution gas chromatography/mass spectrometry (HR GC/MS). The analytical procedure is a liquid extraction, gel permeation clean up (modified US EPA SW846). These procedures were performed at Canviro Analytical Laboratories.

The analytical method for determining the organic carbon content of soils (f_{oc}) was: acid wash of soil, followed by combustion and analysis with a carbon dioxide specific infra-red detector. This procedure was performed at the Organic Geochemistry Laboratory, University of Waterloo.

B.2 QA/QC TECHNIQUES

Sampling Program

A field sampling QA/QC program was used to achieve representative and reliable water quality data.

All groundwater samples were obtained using recognized sampling protocols. This included the use of laboratory pre-cleaned sample containers, dedicated sampling devices, and proper well purging techniques.

A duplicate groundwater sample was obtained from well MWS1. The sample and duplicate sample from this well were labelled MWS1A and MWS1B. Excellent agreement of analytical results were obtained between these two samples.

A travel blank water sample was prepared onsite, transported with the other groundwater samples, and analyzed. This sample was labelled MWS4. The results (Table 4, Appendix E) show trace levels of phenol, naphthalene, benzybutylphthalate, and di-n-butylphthalate. These results indicate that trace levels of these compounds reported in other groundwater samples are not significant and may not be representative of the groundwater quality.

No duplicate or travel blank samples were prepared for soil, lake sediment or tar samples. Typically these types of samples are fairly heterogeneous by nature. Analytical results for different sub-samples of the same sample can be expected to vary by a significant amount. Therefore, duplicate samples are of limited value. There is considerable difficulty in preparing a "clean" travel blank soil sample which has a similar matrix to actual soil samples. Generally, travel blanks are not used for soil and sediment samples.

Laboratory Program

A laboratory QA/QC program was used to establish the precision and reliability of the analytical results.

Laboratory blanks were analyzed along with the samples for all analyses, to estimate the accuracy of the results and also as a check on sources of contamination in the laboratory.

All samples were spiked in the laboratory with known amounts of surrogate compounds before extraction and analysis. The analytically determined concentration of the surrogates is then compared to the known values, as a check on the extraction and analytical techniques.

Also, a laboratory "standard" sample, or spike, containing known amounts of the parameters under analysis, is analyzed along with the soil, sediment and water samples. The analytically determined concentration of the spike is then compared to the known values, as a check on the analytical methods.

Finally, for every sample, a number of PAH and phenolic compounds underwent duplicate analyses. These compounds were analyzed both as a part of the PAH or Phenolics analysis and as a part of the BNA scan. The same extract was used for the original and the duplicate analysis. This provides an estimation of the reproducibility of the analytical method.

The results of the laboratory QA/QC program are summarized below.

> The analytical results from the laboratory blanks were good. Only trace levels of two compounds: chloroform and Di-n-butylphthalate, were detected in the laboratory blanks. Similar levels of these compounds detected in samples are not significant, as they may not be representative of the sample itself.
>
> The repeatability of PAH and Phenolics analyses was generally very good. Replicate analyses were normally within a factor of 2 of the original analysis. The analyses of contaminated samples which required dilutions generally had a poorer repeatability, which is to be expected.
>
> The recovery of surrogate compounds and of the spike sample was generally fair. In many cases the recovery of the surrogate or the spike was less than 80%. This indicates that some under-estimation of similar compounds may have occurred for that sample. In cases where the recovery of the surrogate or spike was over 120%, some over-estimation of similar compounds may have occurred for that sample.

Appendix C

BOREHOLE LOGS AND WELL CONSTRUCTION DETAILS

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS1	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/07
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 97.788
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		G1			Topsoil - dk. brown, sandy, loamy, rootlets, moist, coal bits, NC	
1		C1	30		Sand - brown, mottled, moist, medium to coarse, NC	
2						
3		C2	0			
4		SS1	32	3,3,5,6	Sand - lt. brown, fine to medium, saturated, NC END OF HOLE	
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS2	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/07
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.31
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE INTERVAL (METRE)	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	32	2,4,4,3	Topsoil - black, rootlets, loamy, moist,NC	
1		SS2	38	2,3,6,14	Sand - brown, mottled, some oxidation, medium to coarse, moist, NC, coal bits	
2		SS3	36	4,14,14,15	Sand- red, medium, moist, NC	
		SS4	30	5,11,13,14	Sand - brown, medium, moist, NC	
3		SS5	24	8,8,8,8	NC	
4		SS6	29	4,5,6,6	Sand - brown, mottled, medium to coarse, saturated, NC	
5		SS7	31	9,6,9,6	NC END OF HOLE	
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS3	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/10
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE:
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE INTERVAL (METRE)	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVAL& GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	27	1,2,2,1	Sand - black, rootlets, loamy, moist,NC	
1		SS2	30	7,9,11,10	Sand - brown, mottled, some oxidation, medium to coarse,dry to moist, coal bits, NC	
2		SS3	18	1,1,3,7.	NC	
		SS4	39	5,7,9,10	NC	
3		SS5	29	5,7,8,8	Sand - lt. brown, occaisional red streak, medium to coarse, moist, NC	
4		SS6	26	1,6,7,6	NC	
5		SS7	19	2,4,6,7	Sand - saturated END OF HOLE	
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS4	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/10
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE:
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
1		SS1	29	1,3,4,5	Topsoil - black, sandy, loamy, fibrous, brick/concrete frags,coal bits, damp, NC	
		SS2	39	5,7,11,11	- possibly fill material	
2		SS3	37	7,5,15,12	Sand - brown, mottled, medium to coarse, damp, NC	
		SS4	35	7,9,14,12	NC	
3		SS5	34	9,10,8,14	NC	
4		SS6	23	4,8,8,9	Sand - saturated, NC	
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS5	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/10
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.534 m
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	WELL CONSTRUCTION
	INTERVAL (METRE)	TYPE AND NUMBER	RECOVERY (CM)	6" - 6" - 6" (N)	NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	34	3,5,3,9	Topsoil -black, sandy, rootlets, loamy, damp, NC	
1		SS2	35	2,3,4,4	Sand - reddish, mediom to coarse, coal bits, NC	
2		SS3	36	8,9,9,10	Sand - lt. brown, mottled, medium to coarse, moist, NC	
		SS4	35	6,7,7,8	NC	
3		SS5	34	3,6,7,9	Sand - saturated, NC.	
4						
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS6	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/10
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE:
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	WELL CONSTRUCTION
	INTERVAL (METRE)	TYPE AND NUMBER	RECOVERY (CM)	6" - 6" - 6" (N)	NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	34	1,2,7,11	Topsoil -black, sandy, rootlets, loamy, damp, coal frags, NC	
1		SS2	39	8,11,9,9	Sand- lt. brown, mottled, medium to coarse, damp, NC	
2		SS3	39	10,12,14,11	NC	
		SS4	41	15,17,20,15	NC	
3		SS5	24	6,6,6,7	Sand - saturated	
4						
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS7	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/11
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE:
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	34	3,5,3,9	Topsoil -black, sandy, rootlets, loamy, damp, concrete/brick frags, coal bits, NC	
1		SS2	35	2,3,4,4	Sand - lt. brown, mottled, trace silt, coal frags, gravel frags, moist, NC	
2		SS3	36	8,9,9,10	Sand - dk. brown, mottled, trace silt, moist, black streaks, coal/brick frags, faint odour, TC	
		SS4	35	6,7,7,8	Sand - dk. brown, with black streaks, fine to coarse, moist, odour, TC/VC	
3		SS5	34	3,6,7,9	Sand - rusty colour, black streaks, medium to coarse, odour, saturated, TC/VC	
4						
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS8	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/11
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.382 m
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS, GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	28	1,3,4,3	Topsoil -black, sandy, rootlets, loamy, damp,, coal bits, NC	
1		SS2	38	10,20,20,17	Sand - red, medium, coal frags, moist, NC	
2		SS3	33	6,17,28,19	Sand - brown, mottled, moist, NC	
		SS4	34	9,14,12,14	NC	
3		SS5	31	14,10,12,13	NC	
4		SS6	24	14,9,8,9	Sand - brown, mottled, saturated, NC	
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS9	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/11
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.696 m
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS (6" - 6" - 6") (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	28	1,3,4,3	Topsoil -black, sandy, rootlets, loamy, damp,, coal bits, NC	
1		SS2	38	10,20,20,17	Sand - red, medium, coal frags, moist, NC	
2		SS3	33	6,17,28,19	Sand - brown, mottled, moist, NC NC	
		SS4	34	9,14,12,14	NC	
3		SS5	31	14,10,12,13	NC	
4		SS6	24	14,9,8,9	Sand - brown, mottled, saturated, NC	
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS10	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/11
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE:
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL METRES	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS (6" - 6" - 6" N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS, GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	28	2,2,2,7	Topsoil -black, sandy, rootlets, loamy, damp., coal bits, NC	
1		SS2	33	8,10,14,19	Sand - lt. brown, mottled, brick frags,coal bits, NC	
2		SS3	39	9,14,17,17	NC	
		SS4	31	14,19,18,16	NC	
3		SS5	32	19,18,11,8	NC	
4		SS6	24	12,9,9,10	Sand - brown, mottled, saturated, NC	
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	BHS11	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/11
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE:
-TOP OF RISER PIPE:

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS (6" - 6" - 6")	SOIL DESCRIPTION (NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.)	WELL CONSTRUCTION (CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.)
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	
		SS1	17	1,2,2,4	Topsoil -black, sandy, rootlets, loamy, damp., coal bits, NC	
1		SS2	26	4,8,11,13	Sand - red, black, mottled, medium to coarse, damp, NC	
2		SS3	29	5,9,9,13	Sand - lt. brown, mottled, moist, faint odour, TC	
		SS4	25	13,17,19,24	strong odour, TC - VC	
3		SS5	32	17,9,12,12	strong odour, TC - VC	
4		SS6	34	19,17,11,19	TC - VC, saturated	
5						
6						
7						
8						
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWS1	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/10
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.452 m
-TOP OF RISER PIPE: 100.276 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS, GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
		SS1	39	1,5,5,4	Topsoil - black, rootlets, loamy	bentonite seal
1		SS2	18	5,9,11,11	Sand - lt. brown, mottled, medium to coarse, trace pebbles, moist, coal bits	
2		SS3	22	7,12,13,13	Sand - lt. brown, mottled, medium to coarse, moist, NC	riser pipe
		SS4	31	6,9,11,14	NC	
3		SS5	29	9,6,6,10	NC	bentonite seal
4						native sand
5		SS6	32	7,8,8,12	Sand - grey, mottled, medium to coarse, saturated, NC	
6						
7		SS7	30	1,2,5,8	NC	well screen
8		SS8	23	5,11,12,9	NC	
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWS2	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/11
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.493 m
-TOP OF RISER PIPE: 100.173 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
0		SS1	32	4,20,18,17	Topsoil - black, rootlets, loamy, coal frags, NC	bentonite seal
1		SS2	.34	17,15,18,20	Sand -dk. brown, coal/brick frags, loamy, damp, NC	
2		SS3	31	2,2,2,4	Sand - lt. brown, mottled, medium to coarse, moist, brick frags. NC	riser pipe
		SS4	29	3,6,6,8	Sand - red, medium , moist, NC	
3		SS5	27	7,10,10,10	Sand - brown, medium to coarse, trace pebbles, moist, NC	
4						bentonite seal
						native sand
5		SS6	22	3,4,3,4	Sand - brown, mottled, medium to coarse, saturated, trace gravel, NC	
6						
		SS7	20	4,8,9,12	NC	well screen
7						
8		SS8	39	10,11,12,15	NC	
9		SS9	22	14,14,10,11	NC	
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWS3	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/11
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.910 m
-TOP OF RISER PIPE: 100.590 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (M)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
0		SS1	.28	1,3,7,11	Topsoil - black, rootlets, loamy, coal frags, NC	bentonite seal
1						
2		SS2	44	14,11,17,17	Sand - lt. brown, mottled, medium to coarse, moist, NC	riser pipe
3		SS3	39	11,17,15,16	NC	bentonite seal
4						native sand
5		SS4	34	7,4,3,3	Sand - brown, mottled, medium to coarse, saturated, trace gravel, NC	
6						
7		SS5	29	17,12,9,10	NC	well screen
8		SS6	31	15,11,17,21	NC	
9						
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN1A	PAGE 1 OF 2

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/07
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.033 m
-TOP OF RISER PIPE: 99.763 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
		SS1	43	1,2,3,4	Topsoil - black, rootlets, loamy	bentonite seal
1		SS2			Sand - brown, mottled, medium to coarse, trace pebbles,moist, NC	riser pipe
2		SS3	38	5,8,8,9	- some oxidation, NC	
		SS4	39	5,6,6,8	NC	
3		SS5	34	3,4,4,4	- wet, NC	
4		SS6	32	4,5,6,12	grey, mottled, medium, saturated, NC	
5		SS7	23	7,7,8,12	NC	
6		SS8	20	4,9,7,8	NC	
		SS9	29	8,7,8,11	NC	
7		SS10	0			
8		SS11	31	7,9,11,11	NC	
		SS12	30	4,8,9,14	NC	
9		SS13	24	5,9,14,16	Sand - grey, mottled, medium to coarse, saturated, faint odour, TC	
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN1A	PAGE 2 OF 2

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Standard Chemical Plant Hydrogeologic Investigation
CLIENT: M.O.E.
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear Canada
DRILLING METHOD AND EQUIPMENT: Mobile Drill, B - 57 track mount

DATE: 90/08/07
LOGGER: T. MacGillivray
ELEVATION: -GROUND SURFACE: 99.033 m
-TOP OF RISER PIPE: 99.763 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS (6" - 6" - 6") (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
11		SS14	29	6,27,90	Sand - grey, mottled, medium, saturated, odour, TC	bentonite seal
12		SS15	36	20,9, > 100/ 6"	NC	
13						native sand
14		SS16	31		NC	
15						riser pipe
16		SS17	34		NC	
17		SS18	21			well screen
18					Sand - dk. gray, brown mottled, medium, saturated, strong odour, TC -VC	
19		SS19	22		soils appear darker, possible change noted by driller	
20						
22						

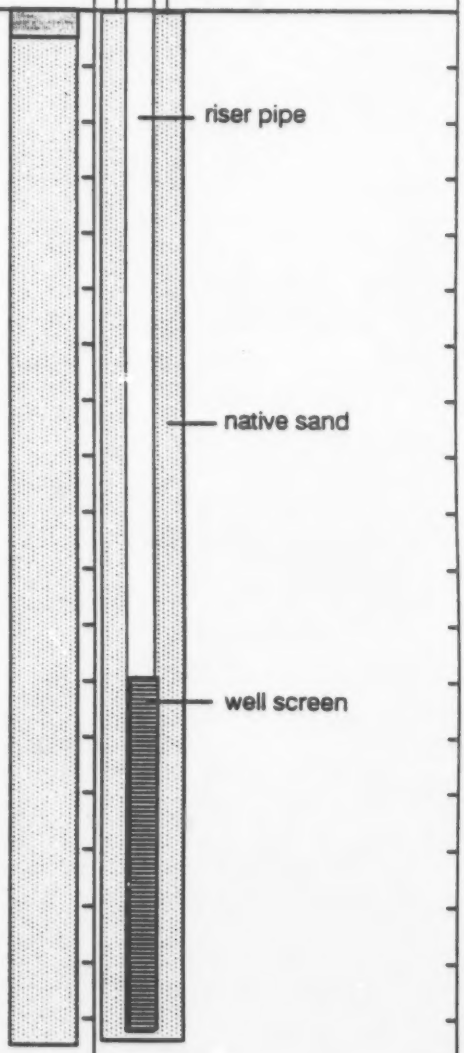
PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN1B	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/07
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.348
-TOP OF RISER PIPE: 100.028

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS (6" - 6" - 6") (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS, GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
1	not sampled				Topsoil - black, loamy, rootlets, Sand - brown, mottled, medium, moist,	riser pipe
2						
3						native sand
4					saturated,	
5						
6						well screen
7						
8						
9						
10						



PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN2A	PAGE 1 OF 2

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/07
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.698 m
-TOP OF RISER PIPE: 100.538 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS: 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS, GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
		SS1	39	4,8,8,10	Topsoil - black, rootlets, loamy	bentonite seal
1		SS2	18	5,5,6,4	Sand - lt. brown, mottled, medium to coarse, trace pebbles, moist, concrete frags, coal bits, faint odour, NC -TC	
2		SS3	18	8,11,10,10	NC	
		SS4	37	2,5,5,7	NC	riser pipe
3		SS5	27	3,5,6,5	- wet, NC	native sand
4		SS6	32	2,3,4,4	Sand - grey, mottled, medium, saturated, NC	
5		SS7	29	3,4,5,7	NC	
6		SS8	24	9,9,11	NC	
		SS9	27	4,5,8,7	NC	
7		SS10	20	6,6,7,19	NC	
8		SS11	27	6,5,7,7	NC	
		SS12	28	5,3,5,11	NC	
9		SS13	0			
10		SS14	21	6,6,9,15	NC	

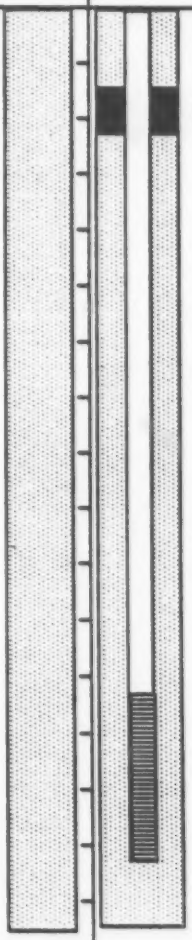
PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN2A	PAGE 2 OF 2

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Standard Chemical Plant Hydrogeologic Investigation
CLIENT: M.O.E.
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear Canada
DRILLING METHOD AND EQUIPMENT: Mobile Drill, B - 57 track mount

DATE: 90/08/08
LOGGER: T. MacGillivray
ELEVATION: -GROUND SURFACE: 99.698 m
-TOP OF RISER PIPE: 100.538 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS (6" - 6" - 6") (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.
11		SS15	10	3,4,4,8	Sand - grey, mottled, medium, saturated, odour, NC
		SS16	0		
12		SS17	25	4,8,9,9	NC
13		SS18	39	5,6,9,6	NC
14		SS19	56	10,12,9,8,	NC
15		SS20	34		NC
16					
17		SS21	28		NC
18		SS22	30		NC
19					
20					
22					



WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS, GRADATION, GROUT INTERVAL, ETC.

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN2 B	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/08
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.631 m
-TOP OF RISER PIPE: 100.511 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS: 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVAL& GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
1		not sampled			Topsoil - black, loamy, rootlets Sand - brown, mottled, medium, moist	riser pipe
2						
3						native sand
4					saturated	
5						
6						well screen
7						
8						
9					Sand - brown, mottled, fine to coarse, saturated, odour, TC (auger bit sample)	
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN3A	PAGE 1 OF 2

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

DATE: 90/08/09
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 99.543 m
-TOP OF RISER PIPE: 100.343 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS: 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS, GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
		SS1	29	1,3,5,5	Topsoil - black, rootlets, loamy	bentonite seal
1		SS2	39	3,5,5,7	Sand - red, mottled, medium to coarse, trace pebbles, dry to damp, NC	
2		SS3	40	5,10,15,18	Sand - lt. brown, mottled, medium to coarse, moist, NC	
		SS4	36	7,8,8,9	NC	riser pipe
3		SS5	37	6,8,8,10	NC	native sand
4		SS6	33	5,6,10,10	Sand - grey, mottled, medium, NC saturated	
5		SS7	29	5,8,11,15	NC	
6		SS8	22	5,7,10,9	NC	
		SS9	25	2,3,4,7	NC	
7						
8		SS10	23	6,7,7,11	NC	bentonite seal
9						
		SS11	12	5,4,3,5	Sand - black lenses, fine to medium, saturated, NC	
10						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN3A	PAGE 2 OF 2

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT: Standard Chemical Plant Hydrogeologic Investigation
CLIENT: M.O.E.
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear Canada
DRILLING METHOD AND EQUIPMENT: Mobile Drill, B - 57 track mount

DATE: 90/08/09
LOGGER: T. MacGillivray
ELEVATION: -GROUND SURFACE: 99.543 m
-TOP OF RISER PIPE: 100.343 m

DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRES)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS: 6" - 6" - 6" (N)	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS GRADATION, GROUT INTERVAL, ETC.
11		SS12	12	5,4,3,5	Sand - grey, mottled, medium, saturated, NC	
12		SS13	51	9,8,8,11	Sand - black lens, fine to coarse, NC	
13					Sand - grey, mottled, medium, saturated , NC	native sand
14		SS14	32	15,17,19,21		
15						riser pipe
16		SS15	29	16,23,34,28	NC	
17		SS16				well screen
18		SS17				
19						
20						
22						

PROJECT NUMBER	WELL NUMBER	
ONT29344.AO	MWN3B	PAGE 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

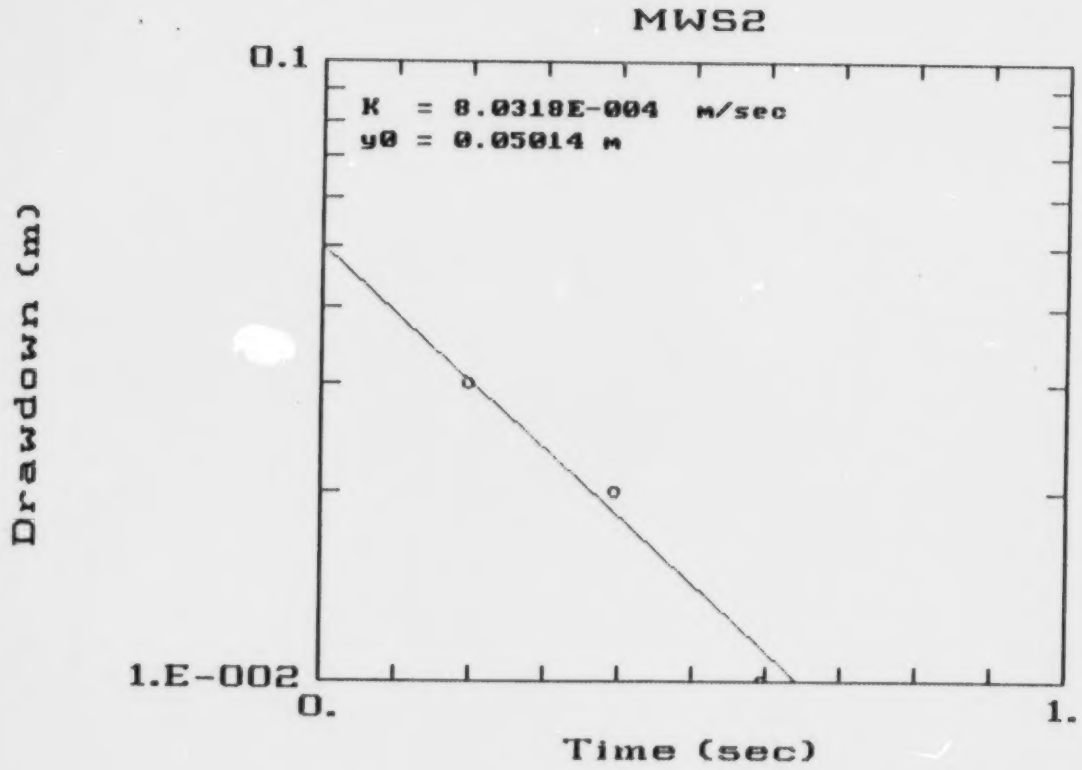
PROJECT: Hydrogeologic Investigation
CLIENT: Former Standard Chemical Site
LOCATION: South River, Ontario
DRILLING CONTRACTOR: Longyear
DRILLING METHOD AND EQUIPMENT: Mobile Drill , B - 57 Track Mount

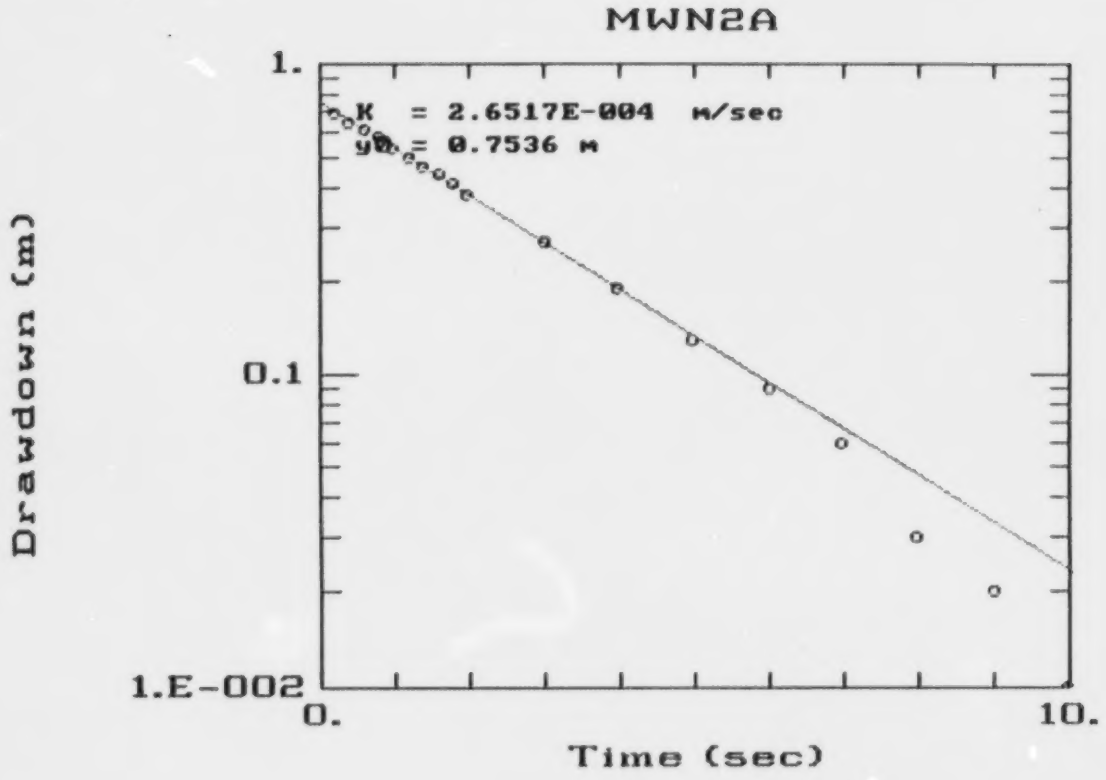
DATE: 90/08/09
LOGGER: Tim MacGillivray
ELEVATION: -GROUND SURFACE: 100.297 m
-TOP OF RISER PIPE: 100.392 m

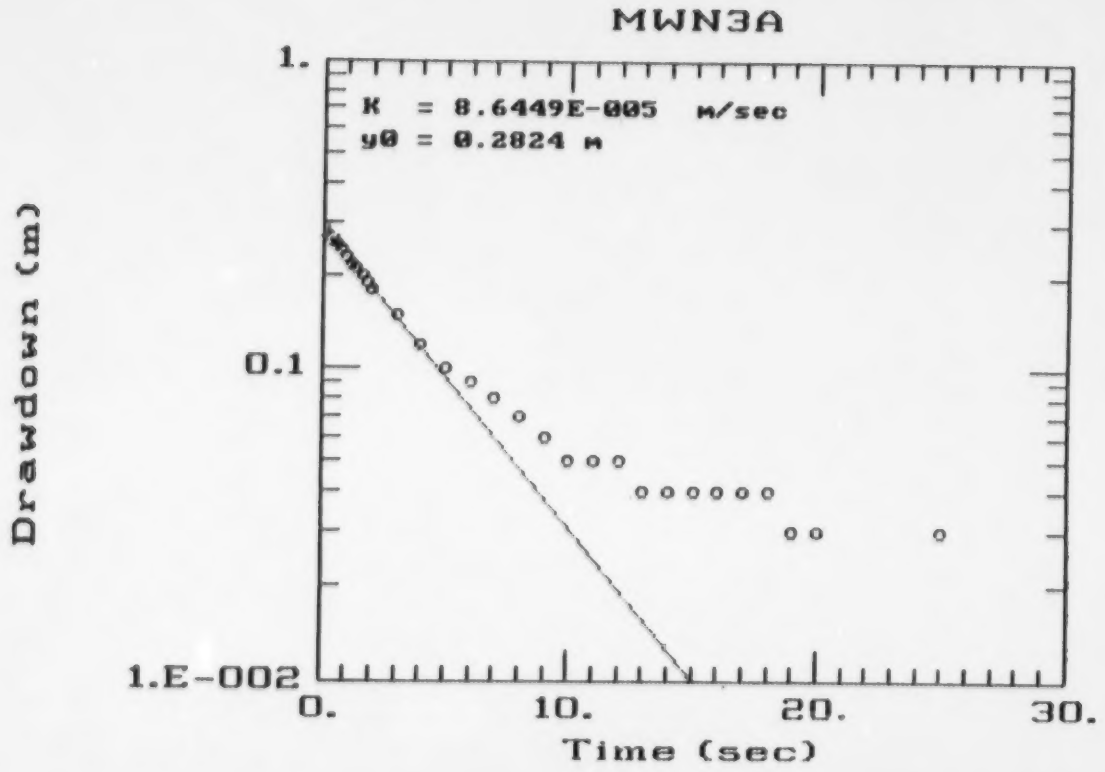
DEPTH BELOW SURFACE (METRES)	SAMPLE: INTERVAL (METRE)	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (CM)	STANDARD PENETRATION TEST RESULTS: 6" - 6" - 6" IN	SOIL DESCRIPTION: NAME, COLOR, SOIL STRUCTURE, PARTICLE SIZE DISTRIBUTION, MOISTURE CONTENT, MINERALOGY, GRADATION OR PLASTICITY, RELATIVE DENSITY OR CONSISTENCY, ETC.	WELL CONSTRUCTION: CASING, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK INTERVALS, GRADATION, GROUT INTERVAL, ETC.
					NC - no contamination TC - trace contamination (faint odour) VC - very contaminated (sheen and strong odour)	locking cap protective casing
		SS1	29	1,3,5,5	Topsoil - black, rootlets, loamy	bentonite seal
1		SS2	39	3,5,5,7	Sand - red, mottled, medium to coarse, trace pebbles, dry to damp, NC	
2		SS3	40	5,10,15,18	Sand - lt. brown, mottled, medium to coarse, moist, NC	
		SS4	36	7,8,8,9	NC	riser pipe
3		SS5	37	6,8,8,10	NC	native sand
4		SS6	33	5,6,10,10	Sand - grey, mottled, medium, NC saturated	
5		SS7	29	5,8,11,15	NC	
6		SS8	22	5,7,10,9	NC	
7		SS9	25	2,3,4,7	NC	
8		SS10	23	6,7,7,11	NC	
9		SS11	12	5,4,3,5	Sand - black lenses, fine to medium, saturated, NC	
10						

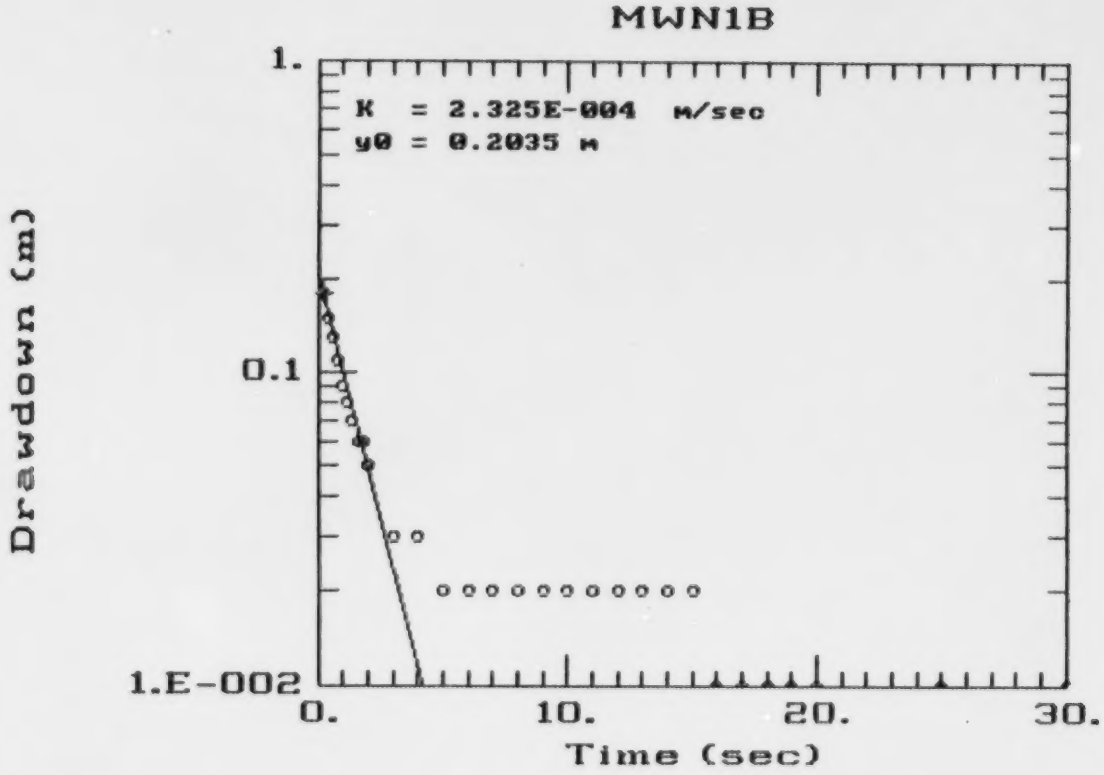
Appendix D

SLUG TEST RESULTS


MWS2
0.1
K = 8.0318E-004 m/sec
y0 = 0.05014 m
Drawdown (m)
1.E-002
0.
1.
Time (sec)


MWN2A
K = 2.6517E-004 m/sec
y = 0.7536 m
1.
0.1
1.E-002
0.
10.
Drawdown (m)
Time (sec)


MWN3A
K = 8.6449E-005 m/sec
y0 = 0.2824 m
1.
0.1
1.E-002
Drawdown (m)
0.
10.
20.
30.
Time (sec)


MWN1B
K = 2.325E-004 m/sec
y0 = 0.2035 m
Drawdown (m)
1.
0.1
1.E-002
0.
10.
20.
30.
Time (sec)

Appendix E

CHEMICAL ANALYSES

SAMPLE IDENTIFICATION	
Sample #	**Sample Name**
5178-01	Lake sediment 0 + 00 (scoop sample)
5178-02	Lake sediment 0 + 40 (scoop sample)
5178-03	Lake sediment 1 + 20 (scoop sample)
5178-04	Core of Lake Sediment 1 + 60
5178-05	Lake sediment 2 + 00 (scoop sample)
5178-06	Tar - surface crust 2 + 40
5178-07	Lake sediment 2 + 80 (scoop sample)
5178-08	Tar - fluid tar under crust 3 + 60
5178-09	Lake Sediment 2 + 40 (scoop sample)
5178-10	Tar - from ground surface near MWN1
5178-11	Soil Samples - BHS7-SS3
5178-12	Soil Samples - MWN3A-SS16
5178-13	Soil Samples - BHS11-SS5
5178-14	Soil Samples - BHS6-SS5
5178-15	Soil Samples - MWN3B-SS7

BASE NEUTRAL EXTRACTABLES BY "GC/MS"

IDENTIFICATION		LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	MDL
IDENTIFICATION NO.		5178-01	5178-02	5178-03	5178-04	5178-05	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1	Camphene	<	<	<	(118)	<	368
2	bis(2-chloroethyl)ether	<	<	<	<	<	57.6
3	o-Cresol	<	<	<	<	<	1.6
4	m-Cresol	<	<	<	<	<	1.6
5	p-Cresol	<	<	<	<	<	1.6
6	bis(2-chloroisopropyl) ether	<	<	<	<	<	14.4
7	Phenol	<	<	<	<	<	9.6
8	Nitrosodi-n-propylamine	<	<	<	<	<	1.6
9	bis(2-chlorethoxy)methane	<	<	<	<	<	1.6
10	Naphthalene	193	290	7.16	18.1	687	1.6
11	2-Chlorophenol	<	<	<	<	<	4.8
12	2,4-Dimethylphenol	<	<	<	<	<	12.8
13	Indole	<	<	<	<	<	3.2
14	2-methylnaphthalene	353	437	10.7	13.2	1140	3.2
15	1-Methylnaphthalene	215	227	8.82	13.2	908	3.2
16	4-chloro-3-methylphenol	<	<	<	<	<	3.2
17	2-chloronaphthalene	<	<	<	<	<	3.2
18	1-chloronaphthelene	<	<	<	<	<	3.2
19	2,6-dichlorophenol	<	<	<	<	<	3.2

( ) - reported at < MDL, all identification criteria were satisfied

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	MDL
IDENTIFICATION NO.		5178-01	5178-02	5178-03	5178-04	5178-05	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
20	2,4-dichlorophenol	<	<	<	<	<	3.2
21	Diphenyl ether	<	<	<	<	<	3.2
22	2,4,6-trichlorophenol	<	<	<	<	<	4.8
23	Acenaphthylene	70.9	<	5.52	<	50.8	3.2
24	2,4-dinitrophenol	<	<	<	<	<	44.8
25	2,6-dinitrotoluene	<	<	<	<	<	91.2
26	4-nitrophenol	<	<	<	<	<	192
27	Acenaphthene	63.2	<	<	14.0	16.3	3.2
28	2,3,5-trichlorophenol	<	<	<	<	<	3.2
29	2,4,5-trichlorophenol	<	<	<	<	<	6.4
30	2,3,4-trichlorophenol	<	<	<	<	<	3.2
31	2,4-dinitrotoluene	<	<	<	<	<	97.6
32	Fluorene	190	112	7.90	31.5	425	3.2
33	4-chlorophenyl phenyl ether	<	<	<	<	<	3.2
34	4,6-dinitro-o-cresol	<	<	<	<	<	1500
35	Total Diphenylamine	<	<	<	<	<	3.2
36	2,3,5,6-tetrachlorophenol	<	<	<	<	<	3.2
37	2,3,4,6-tetrachlorophenol	<	<	<	<	<	3.2
38	2,3,4,5-tetrachlorophenol	<	<	<	<	<	3.2
39	4-bromophenyl phenyl ether	<	<	<	<	<	3.2

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	MDL
IDENTIFICATION NO.		5178-01	5178-02	5178-03	5178-04	5178-05	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
40	Phenanthrene	430	164	40.5	10.2	993	1.6
41	Anthracene	96.2	29.6	7.62	<	156	1.6
42	Pentachlorophenol	<	<	<	<	<	1.6
43	Biphenyl	100	166	<	7.51	149	3.2
44	Fluoranthene	519	92.3	71.3	5.73	924	1.6
45	Pyrene	557	107	74.7	10.3	850	1.6
46	Benzybutylphthalate	56.8	44.5	72.4	35.7	26.6	3.2
47	Benzo (a) anthracene	214	33.0	30.2	<	344	1.6
48	Chrysene	253	41.8	32.2	<	377	17.6
49	bis(2-ethylhexyl)phthalate	<	<	<	<	<	1.6
50	Di-n-butylphthalate	88.3	113	95.9	79.7	81.4	3.2
51	Benzo (b) fluoranthene	277	35.2	40.2	<	381	3.2
52	Benzo (k) Fluoranthene	238	27.1	38.8	<	306	1.6
53	Benzo (a) pyrene	195	25.4	34.1	<	336	1.6
54	Perylene	82.2	9.18	12.2	296	123	1.6
55	5-Nitroacenaphthene	<	<	<	<	<	1.6
56	Indeno(1,2,3-cd)pyrene	237	21.8	40.7	<	305	1.6
57	Dibenzo(ah)anthracene	31.9	<	<	<	31.6	1.6
58	Benzo(ghi)perylene	305	36.3	33.5	<	323	1.6
% RECOVERY OF SURROGATES							
d6-Phenol		ND	ND	ND	ND	ND	
d8-Naphthalene		28	22	41	41	67	
d12-Chrysene		97	98	73	73	79	

NOTE: Samples have NOT been corrected for laboratory blank.

BASE NEUTRAL EXTRACTABLES BY "GC/MS"

IDENTIFICATION		LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	TAR NEAR MW1	MDL
IDENTIFICATION NO.		5178-06*	5178-07*	5178-08*	5178-09*	5178-10*	
NO	COMPOUND	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L
1	Camphene	<	<	<	<	<	368
2	bis(2-chloroethyl)ether	<	<	<	<	<	57.6
3	o-Cresol	<	<	<	<	1350	1.6
4	m-Cresol	<	<	<	<	1300	1.6
5	p-Cresol	<	<	<	<	1100	1.6
6	bis(2-chloroisopropyl) ether	<	<	<	<	<	14.4
7	Phenol	<	<	<	<	<	9.6
8	Nitrosodi-n-propylamine	<	<	<	<	<	1.6
9	bis(2-chlorethoxy)methane	<	<	<	<	<	1.6
10	Naphthalene	47.2	70.1	7.77	39.8	26.4	1.6
11	2-Chlorophenol	<	<	<	<	<	4.8
12	2,4-Dimethylphenol	<	<	<	<	<	12.8
13	Indole	<	<	<	<	<	3.2
14	2-methylnaphthalene	186	24.9	28.8	156	65.1	3.2
15	1-Methylnaphthalene	134	17.4	19.5	110	47.8	3.2
16	4-chloro-3-methylphenol	<	<	<	<	<	3.2
17	2-chloronaphthalene	<	<	<	<	<	3.2
18	1-chloronaphthelene	<	<	<	<	<	3.2
19	2,6-dichlorophenol	<	<	<	<	<	3.2

* due to the nature of the matrix, the following samples have higher MDL's
5178-06: 112 x higher
5178-07: 60 x higher
5178-08: 24 x higher
5178-09: 184 x higher
5178-10: 144 x higher

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	TAR NEAR MW1	MDL
IDENTIFICATION NO.		5178-06*	5178-07*	5178-08*	5178-09*	5178-10*	
NO	COMPOUND	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L
20	2,4-dichlorophenol	<	<	<	<	<	3.2
21	Diphenyl ether	<	<	<	<	<	3.2
22	2,4,6-trichlorophenol	<	<	<	<	<	4.8
23	Acenaphthylene	14.2	<	1.91	9.25	<	3.2
24	2,4-dinitrophenol	<	<	<	<	<	44.8
25	2,6-dinitrotoluene	<	<	<	<	<	91.2
26	4-nitrophenol	<	<	<	<	<	192
27	Acenaphthene	24.7	31.6	3.57	20.9	<	3.2
28	2,3,5-trichlorophenol	<	<	<	<	<	3.2
29	2,4,5-trichlorophenol	<	<	<	<	<	6.4
30	2,3,4-trichlorophenol	<	<	<	<	<	3.2
31	2,4-dinitrotoluene	<	<	<	<	<	97.6
32	Fluorene	152	207	13.5	132	45.8	3.2
33	4-chlorophenyl phenyl ether	<	<	<	<	<	3.2
34	4,6-dinitro-o-cresol	<	<	<	<	<	1500
35	Total Diphenylamine	<	<	<	<	<	3.2
36	2,3,5,6-tetrachlorophenol	<	<	<	<	<	3.2
37	2,3,4,6-tetrachlorophenol	<	<	<	<	<	3.2
38	2,3,4,5-tetrachlorophenol	<	<	<	<	<	3.2
39	4-bromophenyl phenyl ether	<	<	<	<	<	3.2

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	TAR NEAR MAIN1	MDL
IDENTIFICATION NO.		5178-06*	5178-07*	5178-08*	5178-09*	5178-10*	
NO	COMPOUND	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L
40	Phenanthrene	82.5	98.5	<	68.8	33.6	1.6
41	Anthracene	37.5	46.8	<	30.7	<	1.6
42	Pentachlorophenol	<	<	<	<	<	1.6
43	Biphenyl	26.8	35.2	37.0	23.0	<	3.2
44	Fluoranthene	19.0	21.2	<	16.2	10.5	1.6
45	Pyrene	29.0	32.6	1.53	24.5	12.2	1.6
46	Benzybutylphthalate	3.7	<	<	4.75	4.42	3.2
47	Benzo (a) anthracene	8.0	9.1	<	<	<	1.6
48	Chrysene	9.0	9.6	<	<	<	17.6
49	bis(2-ethylhexyl)phthalate	<	<	<	<	<	1.6
50	Di-n-butylphthalate	<	<	1.65	<	<	3.2
51	Benzo (b) fluoranthene	<	<	<	<	<	3.2
52	Benzo (k) Fluoranthene	<	<	<	<	<	1.6
53	Benzo (a) pyrene	<	7.04	<	<	<	1.6
54	Perylene	<	<	<	<	<	1.6
55	5-Nitroacenaphthene	<	<	<	<	<	1.6
56	Indeno(1,2,3-cd)pyrene	<	<	<	<	<	1.6
57	Dibenzo(ah)anthracene	<	<	<	<	<	1.6
58	Benzo(ghi)perylene	<	<	<	<	<	1.6
% RECOVERY OF SURROGATES							
d6-Phenol		ND	ND	ND	ND	ND	
d8-Naphthalene		**	**	**	**	**	
d12-Chrysene		**	**	**	**	**	

NOTE: Samples have NOT been corrected for laboratory blank.

** recoveries not possible due to required dilution

BASE NEUTRAL EXTRACTABLES BY "GC/MS"

IDENTIFICATION		SOIL BHS7-SS3	SOIL MWN3A-SS6	SOIL BHS11-SS5	SOIL BHS6-SS5	SOIL MWN3-SS7	MDL
IDENTIFICATION NO.		5178-11	5178-12	5178-13	5178-14	5178-15	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1	Camphene	<	<	<	<	<	368
2	bis(2-chloroethyl)ether	<	<	<	<	<	57.6
3	o-Cresol	<	<	<	<	<	1.6
4	m-Cresol	<	<	<	<	<	1.6
5	p-Cresol	<	<	<	<	<	1.6
6	bis(2-chloroisopropyl) ether	<	<	<	<	<	14.4
7	Phenol	<	<	<	<	<	9.6
8	Nitrosodi-n-propylamine	<	<	<	<	<	1.6
9	bis(2-chlorethoxy)methane	<	<	<	<	<	1.6
10	Naphthalene	200	<	87.5	<	<	1.6
11	2-Chlorophenol	<	<	<	<	<	4.8
12	2,4-Dimethylphenol	<	<	<	<	<	12.8
13	Indole	<	<	<	<	<	3.2
14	2-methylnaphthalene	1520	<	134	<	<	3.2
15	1-Methylnaphthalene	693	<	105	<	<	3.2
16	4-chloro-3-methylphenol	<	<	<	<	<	3.2
17	2-chloronaphthalene	<	<	<	<	<	3.2
18	1-chloronaphthelene	<	<	<	<	<	3.2
19	2,6-dichlorophenol	<	<	<	<	<	3.2

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		SOIL BHS7-SS3	SOIL MWN3A-SS6	SOIL BHS11-SS5	SOIL BHS6-SS5	SOIL MWN3-SS7	MDL
IDENTIFICATION NO.		5178-11	5178-12	5178-13	5178-14	5178-15	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
20	2,4-dichlorophenol	<	<	<	<	<	3.2
21	Diphenyl ether	<	<	<	<	<	3.2
22	2,4,6-trichlorophenol	<	<	<	<	<	4.8
23	Acenaphthylene	33.3	<	9.55	<	<	3.2
24	2,4-dinitrophenol	<	<	<	<	<	44.8
25	2,6-dinitrotoluene	<	<	<	<	<	91.2
26	4-nitrophenol	<	<	<	<	<	192
27	Acenaphthene	83.2	<	11.6	<	<	3.2
28	2,3,5-trichlorophenol	<	<	<	<	<	3.2
29	2,4,5-trichlorophenol	<	<	<	<	<	6.4
30	2,3,4-trichlorophenol	<	<	<	<	<	3.2
31	2,4-dinitrotoluene	<	<	<	<	<	97.6
32	Fluorene	388	<	20.0	<	<	3.2
33	4-chlorophenyl phenyl ether	<	<	<	<	<	3.2
34	4,6-dinitro-o-cresol	<	<	<	<	<	1500
35	Total Diphenylamine	<	<	<	<	<	3.2
36	2,3,5,6-tetrachlorophenol	<	<	<	<	<	3.2
37	2,3,4,6-tetrachlorophenol	<	<	<	<	<	3.2
38	2,3,4,5-tetrachlorophenol	<	<	<	<	<	3.2
39	4-bromophenyl phenyl ether	<	<	<	<	<	3.2

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		SOIL BHS7-SS3	SOIL MWN3A-SS6	SOIL BHS11-SS5	SOIL BHS6-SS5	SOIL MWN3-SS7	MDL
IDENTIFICATION NO.		5178-11	5178-12	5178-13	5178-14	5178-15	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
40	Phenanthrene	481	15.2	122	5.06	9.50	1.6
41	Anthracene	148	<	16.4	<	<	1.6
42	Pentachlorophenol	<	<	<	<	<	1.6
43	Biphenyl	139	<	16.4	<	<	3.2
44	Fluoranthene	268	<	100	<	<	1.6
45	Pyrene	376	28.0	108	12.4	23.1	1.6
46	Benzybutylphthalate	69.7	50.4	30.9	28.6	15.9	3.2
47	Benzo (a) anthracene	143	<	42.7	<	<	1.6
48	Chrysene	173	<	57.4	<	<	17.6
49	bis(2-ethylhexyl)phthalate	<	<	<	<	<	1.6
50	Di-n-butylphthalate	115	59.3	49.2	43.3	45.5	3.2
51	Benzo (b) fluoranthene	149	<	60.6	<	<	3.2
52	Benzo (k) Fluoranthene	123	<	58.3	<	<	1.6
53	Benzo (a) pyrene	129	<	38.0	<	<	1.6
54	Perylene	42.4	<	11.5	<	<	1.6
55	5-Nitroacenaphthene	<	<	<	<	<	1.6
56	Indeno(1,2,3-cd)pyrene	132	<	43.0	<	<	1.6
57	Dibenzo(ah)anthracene	30.8	<	<	<	<	1.6
58	Benzo(ghi)perylene	180	<	54.4	<	<	1.6
% RECOVERY OF SURROGATES							
d6-Phenol		ND	ND	ND	ND	ND	
d8-Naphthalene		53	31	57	45	34	
d12-Chrysene		90	83	82	77	82	

NOTE: Samples have NOT been corrected for laboratory blank.

** recoveries not possible due to required dilution

BASE NEUTRAL ACID EXTRACTABLES BY "GC/MS"

IDENTIFICATION		LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.			%	
NO	COMPOUND	ug/L		ug/L
1	Camphene	<	62	368
2	bis(2-chloroethyl)ether	<	79	57.6
3	o-Cresol	<	63	1.6
4	m-Cresol	<	73	1.6
5	p-Cresol	<	70	1.6
6	bis(2-chloroisopropyl) ether	<	44	14.4
7	Phenol	<	101	9.6
8	Nitrosodi-n-propylamine	<	102	1.6
9	bis(2-chlorethoxy)methane	<	43	1.6
10	Naphthalene	<	43	1.6
11	2-Chlorophenol	<	135	4.8
12	2,4-Dimethylphenol	<	324	12.8
13	Indole	<	55	3.2
14	2-methylnaphthalene	<	64	3.2
15	1-Methylnaphthalene	<	66	3.2
16	4-chloro-3-methylphenol	<	191	3.2
17	2-chloronaphthalene	<	71	3.2
18	1-chloronaphthelene	<	77	3.2
19	2,6-dichlorophenol	<	138	3.2

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.			%	
NO	COMPOUND	ug/L		ug/L
20	2,4-dichlorophenol	<	120	3.2
21	Diphenyl ether	<	70	3.2
22	2,4,6-trichlorophenol	<	129	4.8
23	Acenaphthylene	<	68	3.2
24	2,4-dinitrophenol	<	105	44.8
25	2,6-dinitrotoluene	<	60	91.2
26	4-nitrophenol	<	60	192
27	Acenaphthene	<	61	3.2
28	2,3,5-trichlorophenol	<	74	3.2
29	2,4,5-trichlorophenol	<	78	6.4
30	2,3,4-trichlorophenol	<	80	3.2
31	2,4-dinitrotoluene	<	53	97.6
32	Fluorene	<	107	3.2
33	4-chlorophenyl phenyl ether	<	56	3.2
34	4,6-dinitro-o-cresol	<	65	1500
35	Total Diphenylamine	<	49	3.2
36	2,3,5,6-tetrachlorophenol	<	76	3.2
37	2,3,4,6-tetrachlorophenol	<	84	3.2
38	2,3,4,5-tetrachlorophenol	<	67	3.2
39	4-bromophenyl phenyl ether	<	54	3.2

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.			%	
NO	COMPOUND	ug/L		ug/L
40	Phenanthrene	<	43	1.6
41	Anthracene	<	53	1.6
42	Pentachlorophenol	<	54	1.6
43	Biphenyl	<	78	3.2
44	Fluoranthene	<	66	1.6
45	Pyrene	<	67	1.6
46	Benzybutylphthalate	<	58	3.2
47	Benzo (a) anthracene	<	57	1.6
48	Chrysene	<	58	17.6
49	bis(2-ethylhexyl)phthalate	<	75	1.6
50	Di-n-butylphthalate	0.26	71	3.2
51	Benzo (b) fluoranthene	<	48	3.2
52	Benzo (k) Fluoranthene	<	103	1.6
53	Benzo (a) pyrene	<	75	1.6
54	Perylene	<	87	1.6
55	5-Nitroacenaphthene	<	54	1.6
56	Indeno(1,2,3-cd)pyrene	<	76	1.6
57	Dibenzo(ah)anthracene	<	75	1.6
58	Benzo(ghi)perylene	<	74	1.6
% RECOVERY OF SURROGATES				
d6-Phenol		ND	ND	
d8-Naphthalene		32	42	
d12-Chrysene		51	56	

NOTE: Samples have NOT been corrected for laboratory blank.

POLYNUCLEAR AROMATIC HYDROCARBONS BY "GC/MS"

IDENTIFICATION	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT
IDENTIFICATION NO.	5178-01	5178-02	5178-03	5178-04	5178-05
	ppb	ppb	ppb	ppb	ppb
Naphthalene	194	248	(10.2)	(17.6)	776
Acenaphthylene	67.2	<	7.70	<	66.0
Acenaphthene	45.1	<	<	15.5	139
Fluorene	127	70.6	(5.6)	22.4	285
Phenanthrene	362	134	36.0	10.3	842
Anthracene	94	30.8	9.90	<	165
Fluoranthene	536	117	78.4	13.6	975
Pyrene	672	127	98.9	<	1060
Benzo (a) anthracene	256	38.4	40.8	<	399
Chrysene	281	47.5	42.4	<	405
Benzo (b) fluoranthene	280	35.8	43.5	<	370
Benzo (k) fluoranthene	225	25.6	34.8	<	265
Benzo (a) pyrene	214	25.1	35.5	<	319
Indeno (1,2,3-cd) pyrene	258	24.7	37.1	<	292
Dibenzo (a,h) anthracene	35.9	<	<	<	19.7
Benzo (ghi) perylene	234	19.5	29.3	<	224
% Recovery Surrogates					
D8-Naphthalene	83	29	55	38	67
D12-Chrysene	133	83	107	105	90

( ) qualifiers were satisfied

POLYNUCLEAR AROMATIC HYDROCARBONS BY "GC/MS"

IDENTIFICATION	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	TAR NEAR MW1
IDENTIFICATION NO.	5178-06	5178-07	5178-08	5178-09	5178-10
	ppm	ppm	ppm	ppm	ppm
Naphthalene	43.0	59.1	8.84	39.0	22.3
Acenaphthylene	14.3	<	1.74	13.4	<
Acenaphthene	17.2	23.8	2.53	16.3	<
Fluorene	72.2	97.1	8.28	68.5	34.0
Phenanthrene	57.0	70.7	<	50.1	<
Anthracene	27.9	6.79	<	24.8	<
Fluoranthene	17.0	20.0	<	14.9	5.87
Pyrene	115	37.8	2.02	28.1	12.0
Benzo (a) anthracene	95.6	10.3	<	<	<
Chrysene	8.08	11.1	<	<	<
Benzo (b) fluoranthene	<	<	<	<	<
Benzo (k) fluoranthene	<	<	<	<	<
Benzo (a) pyrene	<	4.80	<	<	<
Indeno (1,2,3-cd) pyrene	<	<	<	<	<
Dibenzo (a,h) anthracene	<	<	<	<	<
Benzo (ghi) perylene	<	<	<	<	<
% Recovery Surrogates					
D8-Naphthalene	**	**	**	**	**
D12-Chrysene	**	**	**	**	**

** = due to nature of the matrix, the following samples have higher MDL's
5178-06: 112 x higher
5178-07: 60 x higher
5178-08: 21 x higher
5178-09: 184 x higher
5178-10: 144 x higher

POLYNUCLEAR AROMATIC HYDROCARBONS BY "GC/MS"

IDENTIFICATION	SOIL BHS7-SS3	SOIL MWN3A-SS6	SOIL BHS11-SS5	SOIL BHS6-SS5	SOIL MWN3-SS7
IDENTIFICATION NO.	5178-11	5178-12	5178-13	5178-14	5178-15
	ppb	ppb	ppb	ppb	ppb
Naphthalene	234	<	82.8	<	<
Acenaphthylene	54.8	<	19.6	<	<
Acenaphthene	74.1	<	11.4	<	<
Fluorene	288	<	21.8	<	<
Phenanthrene	456	12.6	119	7.18	12.0
Anthracene	156	<	23.1	<	<
Fluoranthene	300	<	118	<	<
Pyrene	498	32.8	151	18.5	27.3
Benzo (a) anthracene	176	<	53.9	<	<
Chrysene	208	<	66.1	<	<
Benzo (b) fluoranthene	189	<	70.0	<	<
Benzo (k) fluoranthene	115	<	51.7	<	<
Benzo (a) pyrene	148	<	44.0	<	<
Indeno (1,2,3-cd) pyrene	183	<	54.4	<	<
Dibenzo (a,h) anthracene	25.3	<	<	<	<
Benzo (ghi) perylene	173	<	50.4	<	<
% Recovery Surrogates					
D8-Naphthalene	95	33	78	59	46
D12-Chrysene	127	89	115	93	83

POLYNUCLEAR AROMATIC HYDROCARBONS BY "GC/MS"

IDENTIFICATION	LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.		%	
	ppb	ppb	ppb
Naphthalene	<	63	24
Acenaphthylene	<	62	9.6
Acenaphthene	<	64	9.6
Fluorene	<	53	9.6
Phenanthrene	<	73	3.2
Anthracene	<	59	4.8
Fluoranthene	<	67	8.0
Pyrene	<	111	8.3
Benzo (a) anthracene	<	117	33.6
Chrysene	<	109	33.6
Benzo (b) fluoranthene	<	120	22.4
Benzo (k) fluoranthene	<	104	22.4
Benzo (a) pyrene	<	67	19.2
Indeno (1,2,3-cd) pyrene	<	108	24.0
Dibenzo (a,h) anthracene	<	103	19.2
Benzo (ghi) perylene	<	94	19.2
% Recovery Surrogates			
D8-Naphthalene	102	99	
D12-Chrysene	168	173	

COAL TAR ACIDS ANALYSIS BY "GC/MS"

IDENTIFICATION	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT
IDENTIFICATION NO.	5178-01	5178-02	5178-03	5178-04	5178-05	5178-06*
	ppb	ppb	ppb	ppb	ppb	ppb
Phenol	<	<	<	<	<	<
o - Cresol	<	<	<	<	<	<
m - Cresol	<	<	<	<	<	<
p - Cresol	<	<	<	<	<	<
2,6 - Dimethyl phenol	<	<	<	<	<	<
2,5 - Dimethyl phenol	<	<	<	<	<	<
2,4 - Dimethyl phenol	<	<	<	<	<	<
3,5 - Dimethyl phenol	<	<	<	<	<	<
2,3 - Dimethyl phenol	<	<	<	<	<	<
3,4 - Dimethyl phenol	<	<	<	<	<	<
Resorcinol	<	<	<	<	<	<

* due to the nature of the matrix these samples have higher MDL's
5178-06: 112 x higher
5178-07: 60 x higher
5178-08: 21 x higher
5178-09: 184 x higher
5178-10: 144 x higher

** sample 5178-10 is reported in ppm

COAL TAR ACIDS ANALYSIS BY "GC/MS"

IDENTIFICATION	LAKE SEDIMENT	LAKE SEDIMENT	LAKE SEDIMENT	TAR NEAR MWN1	SOIL BHS7-SS3	SOIL MWN3A-SS6
IDENTIFICATION NO.	5178-07*	5178-08*	5178-09*	5178-10*	5178-11	5178-12
	ppb	ppb	ppb	ppb	ppb	ppb
Phenol	<	<	<	278	<	<
o - Cresol	<	<	<	214	<	<
m - Cresol	<	<	<	414	<	<
p - Cresol	<	<	<	385	<	<
2,6 - Dimethyl phenol	<	<	<	<	<	<
2,5 - Dimethyl phenol	<	<	<	75.3	<	<
2,4 - Dimethyl phenol	<	<	<	110	<	<
3,5 - Dimethyl phenol	<	614	<	45.7	<	<
2,3 - Dimethyl phenol	<	<	<	<	<	<
3,4 - Dimethyl phenol	<	885	<	99.1	<	<
Resorcinol	<	<	<	64.6	<	<

COAL TAR ACIDS ANALYSIS BY "GC/MS"

IDENTIFICATION	SOIL BHS11-SS5	SOIL BHS6-SS5	SOIL MWN3-SS7	MDL
IDENTIFICATION NO.	5178-13	5178-14	5178-15	
	ppb	ppb	ppb	ppb
Phenol	<	<	<	8.0
o - Cresol	<	<	<	8.0
m - Cresol	<	<	<	8.0
p - Cresol	<	<	<	8.0
2,6 - Dimethyl phenol	<	<	<	8.0
2,5 - Dimethyl phenol	<	<	<	8.0
2,4 - Dimethyl phenol	<	<	<	8.0
3,5 - Dimethyl phenol	<	<	<	8.0
2,3 - Dimethyl phenol	<	<	<	8.0
3,4 - Dimethyl phenol	<	<	<	8.0
Resorcinol	<	<	<	8.0

VOLATILE ORGANIC COMPOUNDS

IDENTIFICATION		LAB BLANK	LAKE SEDIMENT	TAR HEAD RUN1	MDL
IDENTIFICATION NO.			5178-08*	5178-10*	
NO	COMPOUND	ppb	ppb	ppb	ppb
1	Chloromethane	NA	NA	NA	3.6
2	Vinyl chloride	NA	NA	NA	5.0
3	Bromomethane	NA	NA	NA	2.0
4	Chloroethane	NA	NA	NA	1.6
5	Trichlorofluoromethane	<	<	<	3.5
6	Acrolein	<	<	<	2.2
7	1,1-Dichloroethylene	<	<	<	1.6
8	Methylene Chloride	<	3300	3360	1.8
9	Acrylonitrile	<	<	<	2.1
10	trans-1,2-Dichloroethylene	<	<	<	0.7
11	1,1-Dichloroethane	<	<	<	0.5
12	Methyl ethyl ketone	<	4700	7260	1.1
13	Chloroform	1.2	1750	1620	0.4
14	Bromochloromethane	<	<	<	0.2
15	1,1,1-Trichloroethane	<	<	<	0.5
16	Carbon tetrachloride	<	<	<	0.7
17	1,2-Dichloroethane	<	<	<	0.3
18	Benzene	<	<	3380	0.4
19	Trichloroethylene	<	<	<	1.9
20	1,2-Dichloropropane	<	<	<	0.2
21	Bromodichloromethane	<	<	<	0.2
22	2-Chloroethylvinyl ether	<	<	<	0.4
23	trans-1,3-Dichloropropylene	<	<	<	0.3
24	cis-1,3-Dichloropropylene	<	<	<	0.5
25	Toluene	<	1060	25800	0.7
26	1,1,2-Trichloroethane	<	<	<	0.3
27	Tetrachloroethylene	<	<	<	0.8
28	Dibromochloromethane	<	<	<	0.2
29	Ethylene dibromide	<	<	<	0.6
30	Chlorobenzene	<	<	<	0.2
31	m & p Xylene	<	5130	28750	0.6
32	Ethyl benzene	<	2100	17430	2.6
33	Styrene	<	<	<	0.4
34	o-Xylene	<	2880	22700	0.4
35	Bromoform	<	<	<	0.3
36	1,1,2,2-Tetrachloroethane	<	<	<	0.5
37	1,3-Dichlorobenzene	<	<	<	0.2
38	1,4-Dichlorobenzene	<	<	<	0.1
39	1,2-Dichlorobenzene	<	<	<	0.4
% RECOVERY OF SURROGATES					
d5-Bromoethane		101	67	62	
d4-1,2-Dichloroethane		95	89	83	
d8-Toluene		94	71	66	
Bromochloropropane		95	82	117	
d10-Ethylbenzene		97	70	64	

NOTE: Samples have NOT been corrected for laboratory blank.

NA - Not Analyzed

* samples required dilutions therefore MDL's are 500 x those stated

BTXE ANALYSIS

IDENTIFICATION	LAB BLANK	MWN1A *	MWN1B	MWN2A	MWN2B	MWN3A
IDENTIFICATION NO.		5168-01	5168-02	5168-03	5168-04	5168-05
COMPOUND	ppb	ppb	ppb	ppb	ppb	ppb
Benzene	<	215	<	<	<	<
Toluene	<	570	<	<	<	<
m & p Xylene	<	330	<(0.5)	<	<	<
Ethyl benzene	<	210	<(1.0)	<	<	<
o-Xylene	<	155	0.5	<	<	<
% RECOVERY OF SURROGATES						
d5-Bromethane	89	80	95	86	95	89
d4-1,2-Dichloroethane	86	97	92	85	97	91
d8-Toluene	84	88	91	85	92	86
Bromochloropropane	86	122	94	90	94	90
d10-Ethylbenzene	81	90	91	83	90	83

IDENTIFICATION	MWS1A	MWS1B	MWS2	MWS4	TOWN WELL #2	MDL
IDENTIFICATION NO.	5168-06	5168-07	5168-08	5168-09	5168-12	
COMPOUND	ppb	ppb	ppb	ppb	ppb	ppb
Benzene	<	<	<	<	<	0.4
Toluene	<	<	<	<	<	0.7
m & p Xylene	<	<	<	<	<	0.6
Ethyl benzene	<	<	<	<	<	2.6
o-Xylene	<	<	<	<	<	0.4
% RECOVERY OF SURROGATES						
d5-Bromethane	92	92	77	80	100	
d4-1,2-Dichloroethane	91	87	79	86	102	
d8-Toluene	89	86	76	79	97	
Bromochloropropane	90	90	78	83	98	
d10-Ethylbenzene	86	83	74	75	97	

<() Positive identification but below MDL
* Sample required dilution, therefore MDL's are 10x those stated.

BASE NEUTRAL EXTRACTABLES BY "GC/MS"

IDENTIFICATION		* MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MDL
IDENTIFICATION NO.		5168-01	5168-02	5168-03	5168-04	5168-05	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1	Camphene	<	<	<	<	<	2.3
2	bis(2-chloroethyl)ether	<	<	<	<	<	0.36
3	o-Cresol	***	***	***	***	***	0.01
4	m-Cresol	***	***	***	***	***	0.01
5	p-Cresol	***	***	***	***	***	0.01
6	bis(2-chloroisopropyl) ether	<	<	<	<	<	0.09
7	Phenol	1470	0.49	8.45	0.92	0.48	0.06
8	Nitrosodi-n-propylamine	<	<	<	<	<	0.01
9	bis(2-chlorethoxy)methane	<	<	<	<	<	0.01
10	Naphthalene	10.6	3.56	<	<	<	0.01
11	2-Chlorophenol	<	<	<	<	<	0.03
12	2,4-Dimethylphenol	(18000)	2.00	0.44	0.56	<	0.08
13	Indole	<	<	<	<	<	0.02
14	2-methylnaphthalene	3.05	<	0.03	0.02	<	0.02
15	1-Methylnaphthalene	2.55	1.88	<	<	<	0.02
16	4-chloro-3-methylphenol	<	<	<	<	<	0.02
17	2-chloronaphthalene	<	<	<	<	<	0.02
18	1-chloronaphthelene	<	<	<	<	<	0.02
19	2,6-dichlorophenol	<	<	<	<	<	0.02

* MDL is 100x higher due to required dilution
*** See Coal Tar Acid analysis for results.
() Quantitation is approximate due to saturation of detector.

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		* MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MDL
IDENTIFICATION NO.		5168-01	5168-02	5168-03	5168-04	5168-05	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
20	2,4-dichlorophenol	<	<	<	<	<	0.02
21	Diphenyl ether	<	<	<	<	<	0.02
22	2,4,6-trichlorophenol	<	<	<	<	<	0.03
23	Acenaphthylene	<	<	<	<	<	0.02
24	2,4-dinitrophenol	<	<	<	<	<	0.28
25	2,6-dinitrotoluene	<	<	<	<	<	0.57
26	4-nitrophenol	<	<	<	<	<	1.2
27	Acenaphthene	<	0.25	<	<	<	0.02
28	2,3,5-trichlorophenol	<	<	<	<	<	0.02
29	2,4,5-trichlorophenol	<	<	<	<	<	0.04
30	2,3,4-trichlorophenol	<	<	<	<	<	0.02
31	2,4-dinitrotoluene	<	<	<	<	<	0.61
32	Fluorene	<	0.44	<	<	<	0.02
33	4-chlorophenyl phenyl ether	<	<	<	<	<	0.02
34	4,6-dinitro-o-cresol	<	<	<	<	<	9.4
35	Total Diphenylamine	<	0.04	0.14	0.04	<	0.02
36	2,3,5,6-tetrachlorophenol	<	<	<	<	<	0.02
37	2,3,4,6-tetrachlorophenol	<	<	<	<	<	0.02
38	2,3,4,5-tetrachlorophenol	<	<	<	<	<	0.02
39	4-bromophenyl phenyl ether	<	<	<	<	<	0.02

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		* MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MDL
IDENTIFICATION NO.		5168-01	5168-02	5168-03	5168-04	5168-05	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
40	Phenanthrene	<	<	<	<	<	0.01
41	Anthracene	<	<	<	<	<	0.01
42	Pentachlorophenol	<	<	<	<	<	0.01
43	Biphenyl	<	0.64	<	<	<	0.02
44	Fluoranthene	<	<	<	<	<	0.01
45	Pyrene	<	<	<	<	<	0.01
46	Benzybutylphthalate	<	0.93	1.16	1.05	0.48	0.02
47	Benzo (a) anthracene	<	<	<	<	<	0.01
48	Chrysene	<	<	<	<	<	0.11
49	bis(2-ethylhexyl)phthalate	<	<	<	<	<	0.01
50	Di-n-butylphthalate	9.77	0.38	0.43	0.28	0.26	0.02
51	Benzo (b) fluoranthene	<	<	<	<	<	0.02
52	Benzo (k) Fluoranthene	<	<	<	<	<	0.01
53	Benzo (a) pyrene	<	<	<	<	<	0.01
54	Perylene	<	<	<	<	<	0.01
55	5-Nitroacenaphthene	<	<	<	<	<	0.01
56	Indeno(1,2,3-cd)pyrene	<	<	<	<	<	0.01
57	Dibenzo(ah)anthracene	<	<	<	<	<	0.01
58	Benzo(ghi)perylene	<	<	<	<	<	0.01
% RECOVERY OF SURROGATES							
d6-Phenol		**	86	94	65	87	
d8-Naphthalene		**	60	71	33	38	
d12-Chrysene		**	110	116	94	95	

** Recoveries not possible due to matrix interference and dilutions.

BASE NEUTRAL EXTRACTABLES BY "GC/MS"

IDENTIFICATION		MWS1A	MWS1B	MWS2	MWS4	RIVER NEAR MWN1	MDL
IDENTIFICATION NO.		5168-06	5168-07	5168-08	5168-09	5168-10	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
1	Camphene	<	<	<	<	<	2.3
2	bis(2-chloroethyl)ether	<	<	<	<	<	0.36
3	o-Cresol	***	***	***	***	***	0.01
4	m-Cresol	***	***	***	***	***	0.01
5	p-Cresol	***	***	***	***	***	0.01
6	bis(2-chloroisopropyl) ether	<	<	<	<	<	0.09
7	Phenol	0.31	0.31	0.86	0.34	0.67	0.06
8	Nitrosodi-n-propylamine	<	<	<	<	<	0.01
9	bis(2-chlorethoxy)methane	<	<	<	<	<	0.01
10	Naphthalene	<	<	<	<	<	0.01
11	2-Chlorophenol	<	<	<	<	<	0.03
12	2,4-Dimethylphenol	<	<	<	<	0.73	0.08
13	Indole	<	<	<	<	<	0.02
14	2-methylnaphthalene	<	<	<	<	0.02	0.02
15	1-Methylnaphthalene	<	<	<	<	<	0.02
16	4-chloro-3-methylphenol	<	<	<	<	<	0.02
17	2-chloronaphthalene	<	<	<	<	<	0.02
18	1-chloronaphthelene	<	<	<	<	<	0.02
19	2,6-dichlorophenol	<	<	<	<	<	0.02

*** See Coal Tar Acid analysis for results.

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		MWS1A	MWS1B	MWS2	MWS4	RIVER NEAR MWN1	MDL
IDENTIFICATION NO.		5168-06	5168-07	5168-08	5168-09	5168-10	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
20	2,4-dichlorophenol	<	<	<	<	<	0.02
21	Diphenyl ether	<	<	<	<	<	0.02
22	2,4,6-trichlorophenol	<	<	<	<	<	0.03
23	Acenaphthylene	<	<	<	<	<	0.02
24	2,4-dinitrophenol	<	<	<	<	<	0.28
25	2,6-dinitrotoluene	<	<	<	<	<	0.57
26	4-nitrophenol	<	<	<	<	<	1.2
27	Acenaphthene	<	<	<	<	<	0.02
28	2,3,5-trichlorophenol	<	<	<	<	<	0.02
29	2,4,5-trichlorophenol	<	<	<	<	<	0.04
30	2,3,4-trichlorophenol	<	<	<	<	<	0.02
31	2,4-dinitrotoluene	<	<	<	<	<	0.61
32	Fluorene	<	<	<	<	<	0.02
33	4-chlorophenyl phenyl ether	<	<	<	<	<	0.02
34	4,6-dinitro-o-cresol	<	<	<	<	<	9.4
35	Total Diphenylamine	<	<	<	<	<	0.02
36	2,3,5,6-tetrachlorophenol	<	<	<	<	<	0.02
37	2,3,4,6-tetrachlorophenol	<	<	<	<	<	0.02
38	2,3,4,5-tetrachlorophenol	<	<	<	<	<	0.02
39	4-bromophenyl phenyl ether	<	<	<	<	<	0.02

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		MWS1A	MWS1B	MWS2	MWS4	RIVER NEAR MWN1	MDL
IDENTIFICATION NO.		5168-06	5168-07	5168-08	5168-09	5168-10	
NO	COMPOUND	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
40	Phenanthrene	<	<	<	<	<	0.01
41	Anthracene	<	<	<	<	<	0.01
?	Pentachlorophenol	<	<	<	<	<	0.01
43	Biphenyl	<	<	<	<	<	0.02
44	Fluoranthene	<	<	<	<	<	0.01
45	Pyrene	<	<	<	<	<	0.01
46	Benzybutylphthalate	0.67	0.44	0.49	0.33	0.23	0.02
47	Benzo (a) anthracene	<	<	<	<	<	0.01
48	Chrysene	<	<	<	<	<	0.11
49	bis(2-ethylhexyl)phthalate	<	<	<	<	<	0.01
50	Di-n-butylphthalate	0.47	0.29	0.23	0.21	0.51	0.02
51	Benzo (b) fluoranthene	<	<	<	<	<	0.02
52	Benzo (k) Fluoranthene	<	<	<	<	<	0.01
53	Benzo (a) pyrene	<	<	<	<	<	0.01
54	Perylene	<	<	<	<	<	0.01
55	5-Nitroacenaphthene	<	<	<	<	<	0.01
56	Indeno(1,2,3-cd)pyrene	<	<	<	<	<	0.01
57	Dibenzo(ah)anthracene	<	<	<	<	<	0.01
58	Benzo(ghi)perylene	<	<	<	<	<	0.01
% RECOVERY OF SURROGATES							
d6-Phenol		84	79	78	75	74	
d8-Naphthalene		36	34	41	42	20	
d12-Chrysene		98	91	88	84	79	

BASE NEUTRAL EXTRACTABLES BY "GC/MS"

IDENTIFICATION		RIVER NEAR MW51	TOWN WELL #2	LAB BLANK BLANK	RECOVERY SPIKE SPIKE	MDL MDL
IDENTIFICATION NO.		5168-11	5168-12			
NO	COMPOUND	ug/L	ug/L	ug/L	%	ug/L
1	Camphene	<	<	<	62	2.3
2	bis(2-chloroethyl)ether	<	<	<	79	0.36
3	o-Cresol	***	***	<	63	0.01
4	m-Cresol	***	***	<	73	0.01
5	p-Cresol	***	***	<	70	0.01
6	bis(2-chloroisopropyl) ether	<	<	<	44	0.09
7	Phenol	0.52	0.44	<	101	0.06
8	Nitrosodi-n-propylamine	<	<	<	102	0.01
9	bis(2-chlorethoxy)methane	<	<	<	43	0.01
10	Naphthalene	<	<	<	43	0.01
11	2-Chlorophenol	<	<	<	135	0.03
12	2,4-Dimethylphenol	<	<	<	324	0.08
13	Indole	<	<	<	55	0.02
14	2-methylnaphthalene	<	<	<	64	0.02
15	1-Methylnaphthalene	<	<	<	66	0.02
16	4-chloro-3-methylphenol	<	<	<	191	0.02
17	2-chloronaphthalene	<	<	<	71	0.02
18	1-chloronaphthelene	<	<	<	77	0.02
19	2,6-dichlorophenol	<	<	<	138	0.02

*** See Coal Tar Acid Analysis for results.

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		RIVER NEAR MWS1	TOWN WELL #2	LAB BLANK BLANK	RECOVERY SPIKE SPIKE	MDL MDL
IDENTIFICATION NO.		5168-11	5168-12			
NO	COMPOUND	ug/L	ug/L	ug/L	%	ug/L
20	2,4-dichlorophenol	<	<	<	120	0.02
21	Diphenyl ether	<	<	<	70	0.02
22	2,4,6-trichlorophenol	<	<	<	129	0.03
23	Acenaphthylene	<	<	<	68	0.02
24	2,4-dinitrophenol	<	<	<	105	0.28
25	2,6-dinitrotoluene	<	<	<	60	0.57
26	4-nitrophenol	<	<	<	60	1.2
27	Acenaphthene	<	<	<	61	0.02
28	2,3,5-trichlorophenol	<	<	<	74	0.02
29	2,4,5-trichlorophenol	<	<	<	78	0.04
30	2,3,4-trichlorophenol	<	<	<	80	0.02
31	2,4-dinitrotoluene	<	<	<	53	0.61
32	Fluorene	<	<	<	107	0.02
33	4-chlorophenyl phenyl ether	<	<	<	56	0.02
34	4,6-dinitro-o-cresol	<	<	<	65	9.4
35	Total Diphenylamine	<	<	<	49	0.02
36	2,3,5,6-tetrachlorophenol	<	<	<	76	0.02
37	2,3,4,6-tetrachlorophenol	<	<	<	84	0.02
38	2,3,4,5-tetrachlorophenol	<	<	<	67	0.02
39	4-bromophenyl phenyl ether	<	<	<	54	0.02

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		RIVER NEAR MWS1	TOWN WELL #2	LAB BLANK BLANK	RECOVERY SPIKE SPIKE	MDL MDL
IDENTIFICATION NO.		5168-11	5168-12			
NO	COMPOUND	ug/L	ug/L	ug/L	%	ug/L
40	Phenanthrene	<	<	<	43	0.01
41	Anthracene	<	<	<	53	0.01
42	Pentachlorophenol	<	<	<	54	0.01
43	Biphenyl	<	<	<	78	0.02
44	Fluoranthene	<	<	<	66	0.01
45	Pyrene	<	<	<	67	0.01
46	Benzybutylphthalate	0.30	0.12	<	58	0.02
47	Benzo (a) anthracene	<	<	<	57	0.01
48	Chrysene	<	<	<	58	0.11
49	bis(2-ethylhexyl)phthalate	<	<	<	75	0.01
50	Di-n-butylphthalate	0.66	0.47	0.26	71	0.02
51	Benzo (b) fluoranthene	<	<	<	48	0.02
52	Benzo (k) Fluoranthene	<	<	<	103	0.01
53	Benzo (a) pyrene	<	<	<	75	0.01
54	Perylene	<	<	<	87	0.01
55	5-Nitroacenaphthene	<	<	<	54	0.01
56	Indeno(1,2,3-cd)pyrene	<	<	<	76	0.01
57	Dibenzo(ah)anthracene	<	<	<	75	0.01
58	Benzo(ghi)perylene	<	<	<	74	0.01
% RECOVERY OF SURROGATES						
d6-Phenol		102	115	NS	NS	
d8-Naphthalene		18	33	32	42	
d12-Chrysene		88	88	51	56	

NS = Not spiked

POLYNUCLEAR AROMATIC HYDROCARBONS BY "GC/MS"

IDENTIFICATION	MWN1A *	MWN1B	MWN2A	MWN2B	MWN3A	MDL
IDENTIFICATION NO.	5168-01	5168-02	5168-03	5168-04	5168-05	
	ppb	ppb	ppb	ppb	ppb	ppb
Naphthalene	10.5	4.14	0.039	0.035	0.030	0.015
Acenaphthylene	<	<	<	<	<	0.006
Acenaphthene	<	0.32	<	<	<	0.006
Fluorene	<	0.38	<	<	<	0.006
Phenanthrene	<	<	<	<	<	0.002
Anthracene	<	<	<	<	<	0.003
Fluoranthene	<	<	<	<	<	0.005
Pyrene	<	<	<	<	<	0.005
Benzo (a) anthracene	<	<	<	<	<	0.021
Chrysene	<	<	<	<	<	0.021
Benzo (b) fluoranthene	<	<	<	<	<	0.014
Benzo (k) fluoranthene	<	<	<	<	<	0.014
Benzo (a) pyrene	<	<	<	<	<	0.012
Indeno (1,2,3-cd) pyrene	<	<	<	<	<	0.015
Dibenzo (a,h) anthracene	<	<	<	<	<	0.012
Benzo (ghi) perylene	<	<	<	<	<	0.012
% Recovery Surrogates						
D8-Naphthalene	**	65	72	53	73	
D12-Chrysene	**	161	166	141	169	

* MDL is 100x higher due to required dilution.
** Recovery not possible due to required dilution.

POLYNUCLEAR AROMATIC HYDROCARBONS BY "GC/MS"

IDENTIFICATION	MWSIA	MWS1B	MWS2	MWS4	RIVER NEAR MWN1	MDL MDL MDL
IDENTIFICATION NO.	5168-06	5168-07	5168-08	5168-09	5168-10	
	ppb	ppb	ppb	ppb	ppb	ppb
Naphthalene	<	<	0.038	0.078	0.060	0.015
Acenaphthylene	<	<	<	<	<	0.006
Acenaphthene	<	<	<	<	<	0.006
Fluorene	<	<	<	<	<	0.006
Phenanthrene	<	<	<	<	<	0.002
Anthracene	<	<	<	<	<	0.003
Fluoranthene	<	<	<	<	0.008	0.005
Pyrene	<	<	<	<	0.008	0.005
Benzo (a) anthracene	<	<	<	<	<	0.021
Chrysene	<	<	<	<	<	0.021
Benzo (b) fluoranthene	<	<	<	<	<	0.014
Benzo (k) fluoranthene	<	<	<	<	<	0.014
Benzo (a) pyrene	<	<	<	<	<	0.012
Indeno (1,2,3-cd) pyrene	<	<	<	<	<	0.015
Dibenzo (a,h) anthracene	<	<	<	<	<	0.012
Benzo (ghi) perylene	<	<	<	<	<	0.012
% Recovery Surrogates						
D8-Naphthalene	56	71	68	69	86	
D12-Chrysene	130	172	157	134	168	

POLYNUCLEAR AROMATIC HYDROCARBONS BY "GC/MS"

IDENTIFICATION NO.	RIVER NEAR MWS1	TOWN WELL #2	LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.	5168-11	5168-12			
	ppb	ppb	ppb	%	ppb
Naphthalene	<	0.032	<	63	0.015
Acenaphthylene	<	<	<	62	0.006
Acenaphthene	<	<	<	64	0.006
Fluorene	<	<	<	53	0.006
Phenanthrene	<	<	<	73	0.002
Anthracene	<	<	<	59	0.003
Fluoranthene	0.010	<	<	67	0.005
Pyrene	0.010	<	<	111	0.005
Benzo (a) anthracene	<	<	<	117	0.021
Chrysene	<	<	<	109	0.021
Benzo (b) fluoranthene	<	<	<	120	0.014
Benzo (k) fluoranthene	<	<	<	104	0.014
Benzo (a) pyrene	<	<	<	67	0.012
Indeno (1,2,3-cd) pyrene	<	<	<	108	0.015
Dibenzo (a,h) anthracene	<	<	<	103	0.012
Benzo (ghi) perylene	<	<	<	94	0.012
% Recovery Surrogates					
D8-Naphthalene	69	82	102	99	
D12-Chrysene	155	168	168	173	

COAL TAR ACIDS ANALYSIS BY "GC/MS"

IDENTIFICATION	MWN1A *	MWN1B	MWN2A	MWN2B	MWN3A	MDL
IDENTIFICATION NO.	5168-01	5168-02	5168-03	5168-04	5168-05	
	ppb	ppb	ppb	ppb	ppb	ppb
Phenol	638	0.35	0.53	0.68	0.29	0.07
o - Cresol	1820	0.62	0.07	0.33	<	0.07
m - Cresol	(2000)	0.14	<	0.42	<	0.07
p - Cresol	(3700)	0.19	0.12	0.28	<	0.07
2,6 - Dimethyl phenol	5520	1.47	<	<	<	0.07
2,5 - Dimethyl phenol	3420	<	<	0.11	<	0.07
2,4 - Dimethyl phenol	5750	<	<	0.11	<	0.07
3,5 - Dimethyl phenol	4360	2.54	<	0.16	<	0.07
2,3 - Dimethyl phenol	1450	<	<	<	<	0.07
3,4 - Dimethyl phenol	1180	<	<	0.08	<	0.07
Resorcinol	199	<	<	<	<	0.07
% Recovery Surrogate (2-Fluorophenol)	**	85	95	79	85	

* MDL is 100x higher due to required dilution
** Recoveries not possible due to required dilution
( ) quantitation is approximate due to saturation of detector

COAL TAR ACIDS ANALYSIS BY "GC/MS"

IDENTIFICATION	MWS1A	MWS1B	MWS2	MWS4	RIVER NEAR MWN1	MDL
IDENTIFICATION NO.	5168-06	5168-07	5168-08	5168-09	5168-10	
	ppb	ppb	ppb	ppb	ppb	ppb
Phenol	0.20	0.23	0.57	0.22	0.38	0.07
o - Cresol	<	<	<	<	0.14	0.07
m - Cresol	<	<	<	<	0.28	0.07
p - Cresol	<	<	<	<	0.14	0.07
2,6 - Dimethyl phenol	<	<	<	<	<	0.07
2,5 - Dimethyl phenol	<	<	<	<	0.09	0.07
2,4 - Dimethyl phenol	<	<	<	<	0.11	0.07
3,5 - Dimethyl phenol	<	<	<	<	0.25	0.07
2,3 - Dimethyl phenol	<	<	<	<	<	0.07
3,4 - Dimethyl phenol	<	<	<	<	<	0.07
Resorcinol	<	<	<	<	<	0.07
% Recovery Surrogate (2-Fluorophenol)	82	84	85	82	66	

COAL TAR ACIDS ANALYSIS BY "GC/MS"

IDENTIFICATION	RIVER NEAR MWS1	TOWN WELL #2	LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.	5168-11	5168-12			
	ppb	ppb	ppb	%	ppb
Phenol	0.26	0.21	<	90	0.07
o - Cresol	<	<	<	123	0.07
m - Cresol	<	<	<	84	0.07
p - Cresol	<	<	<	91	0.07
2,6 - Dimethyl phenol	<	<	<	17	0.07
2,5 - Dimethyl phenol	<	<	<	51	0.07
2,4 - Dimethyl phenol	<	<	<	75	0.07
3,5 - Dimethyl phenol	0.53	<	<	85	0.07
2,3 - Dimethyl phenol	<	<	<	56	0.07
3,4 - Dimethyl phenol	<	<	<	91	0.07
Resorcinol	<	<	<	89	0.07
% Recovery Surrogate (2-Fluorophenol)	80	88	80	99	

ORGANIC GEOCHEMISTRY LABORATORY
UNIVERSITY OF WATERLOO

FRACTION ORGANIC CARBON
10/10/90

SAMPLE		FOC (%)
BHS3	SS7	0.023
MWS1	SS8	0.038

Appendix F

DESCRIPTION OF THE GROUNDWATER MODEL

F.1 DESCRIPTION OF THE COMPUTER CODE

Flowpath is a combined finite-difference and particle tracking model for the analysis of two-dimensional groundwater flow and time-related capture zones of pumping wells.

Flowpath can model unconfined, confined and leaky aquifers. It accounts for heterogeneous and isotropic aquifer materials, and spacially variable recharge or infiltration.

The model calculates the steady-state hydraulic head distribution, the groundwater velocity field, time-related paths of groundwater particles, and time-related capture zones for pumping wells. Dispersion and diffusion processes are not considered in the particle-tracking computation.

F.2 DESCRIPTION OF THE SOUTH RIVER MODEL

The two-dimension model of the South River aquifer was constructed based on the available geological information. The extent of the aquifer is thought to correspond to the extent of the buried bedrock valley (Section 3.2).

The modelled domain and the model grid are illustrated in Figure F1. The boundaries of the model were constructed as follows:

> northeast and east: This corresponds to the shore of Forest Lake. It was modelled as a constant head boundary, with hydraulic head equal to the water elevation in Forest Lake.
>
> northwest and south: This corresponds to the edge of the bedrock valley, and presumably of the aquifer. It was modelled as a "no-flow", or impermeable boundary.
>
> west: this boundary was set as a "no-flow" boundary. It is located far from the areas of interest and is not expected to have significant effect on the model solution in the areas of interest.

The thickness of the aquifer was estimated from onsite monitor well logs, local water well records and geophysical resistivity survey information (see Section 3.2). Figure F2 shows the distribution of aquifer thickness used in the model.

Infiltration rates into the aquifer from precipitation were set at 20 cm/year. This is equivalent to 22% of the annual precipitation of 90 cm/year (Ontario Ministry of Natural Resources, 1984). This is a conservative infiltration value given the permeable nature of the soils onsite.

The pumping rate of the municipal well was calculated by dividing the total volume of water produced from September 1989 to August 1990 by the number of days in that

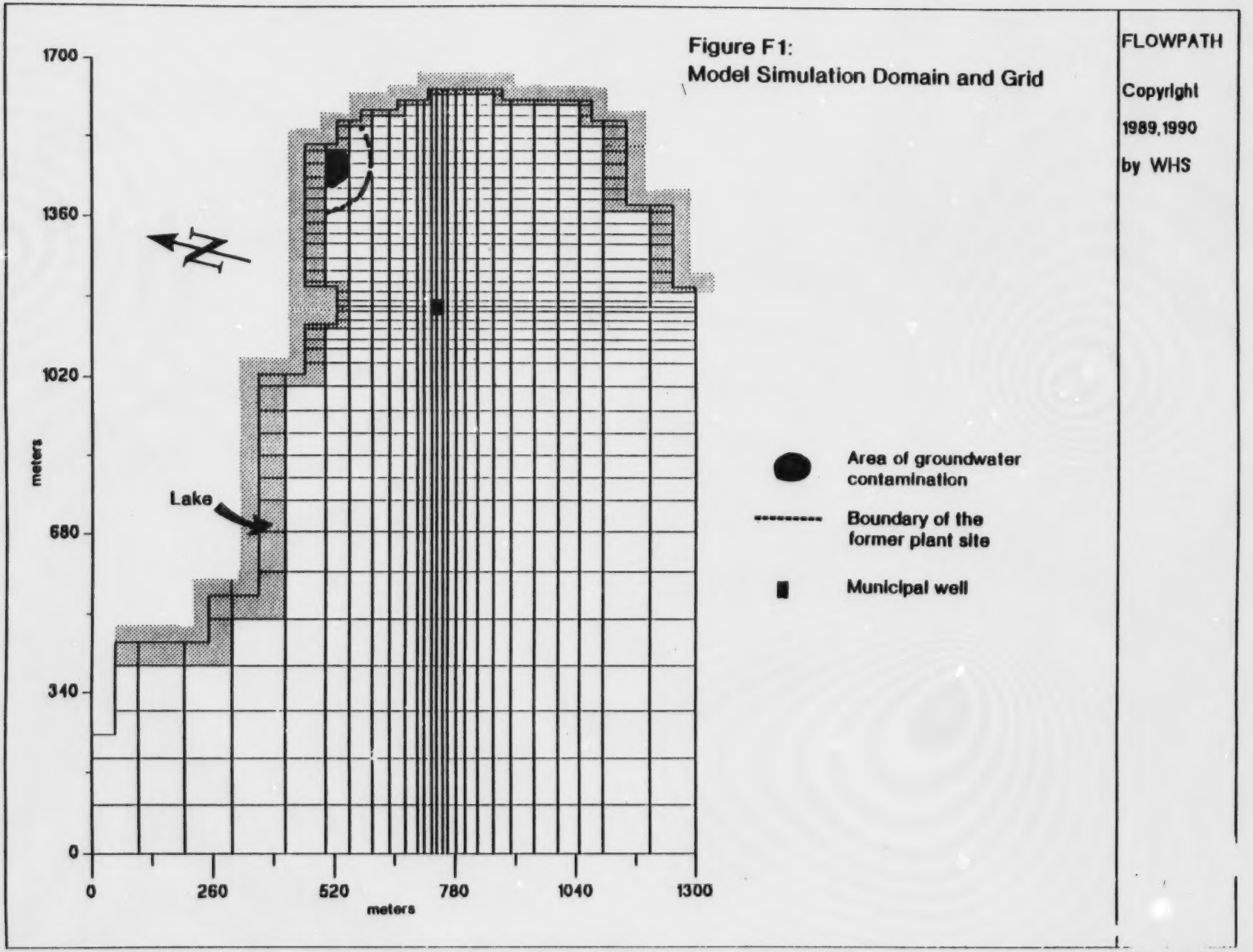


Figure F1:
Model Simulation Domain and Grid
FLOWPATH
Copyright
1989,1990
by WHS
1700
1360
1020
680
340
0
meters
Lake
N
0
260
520
780
1040
1300
meters
Area of groundwater contamination
Boundary of the former plant site
Municipal well

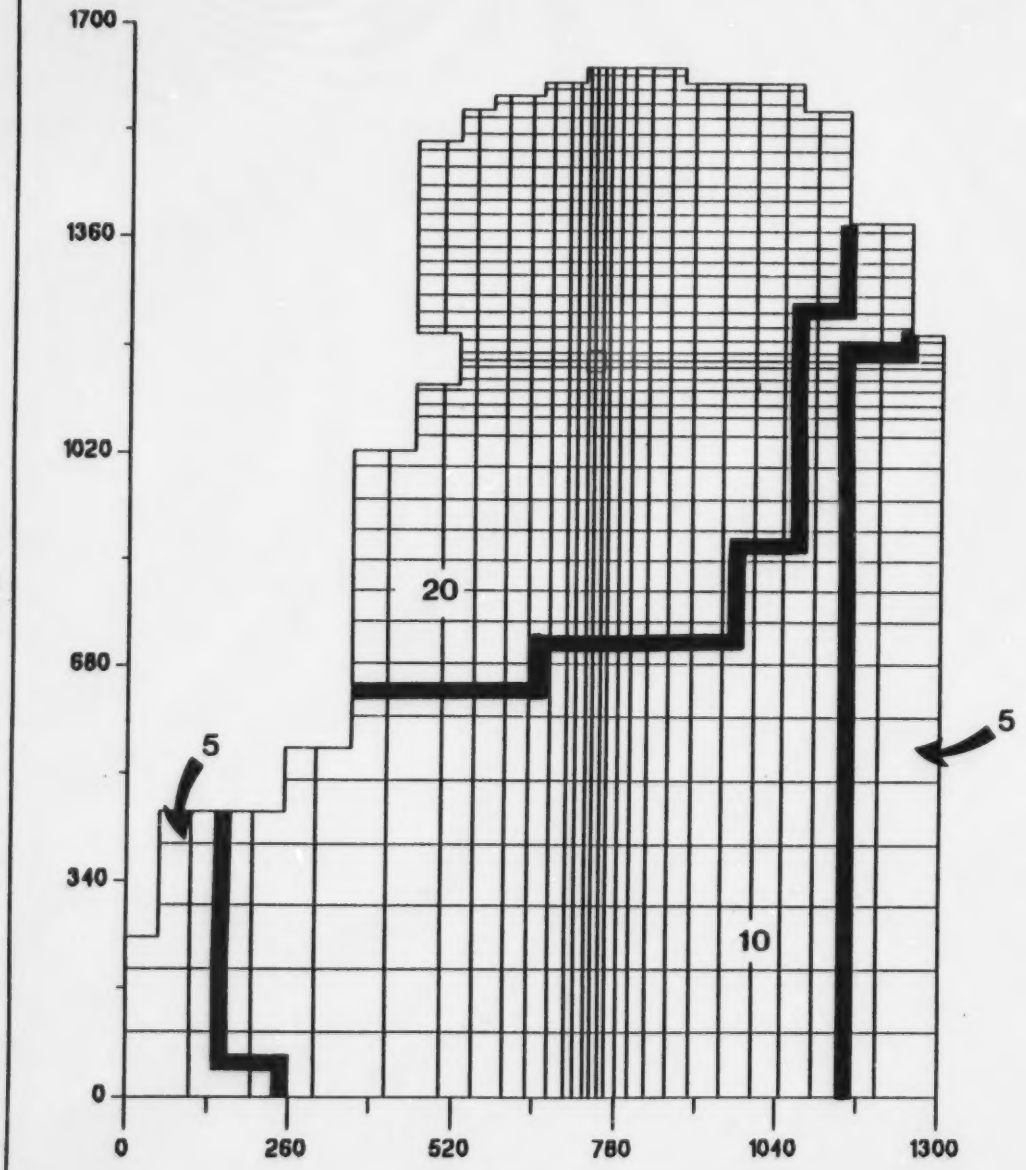


Figure F2:

Base of Sand Aquifer

(meters below ground surface)

FLOWPATH

Copyright
1989,1990
by WHS

period. This resulted in an average pumping rate of 390 m^3/day.

The aquifer was modelled as homogeneous and isotropic, with a hydraulic conductivity of 2 x 10-3 m/s (Section 3.3).

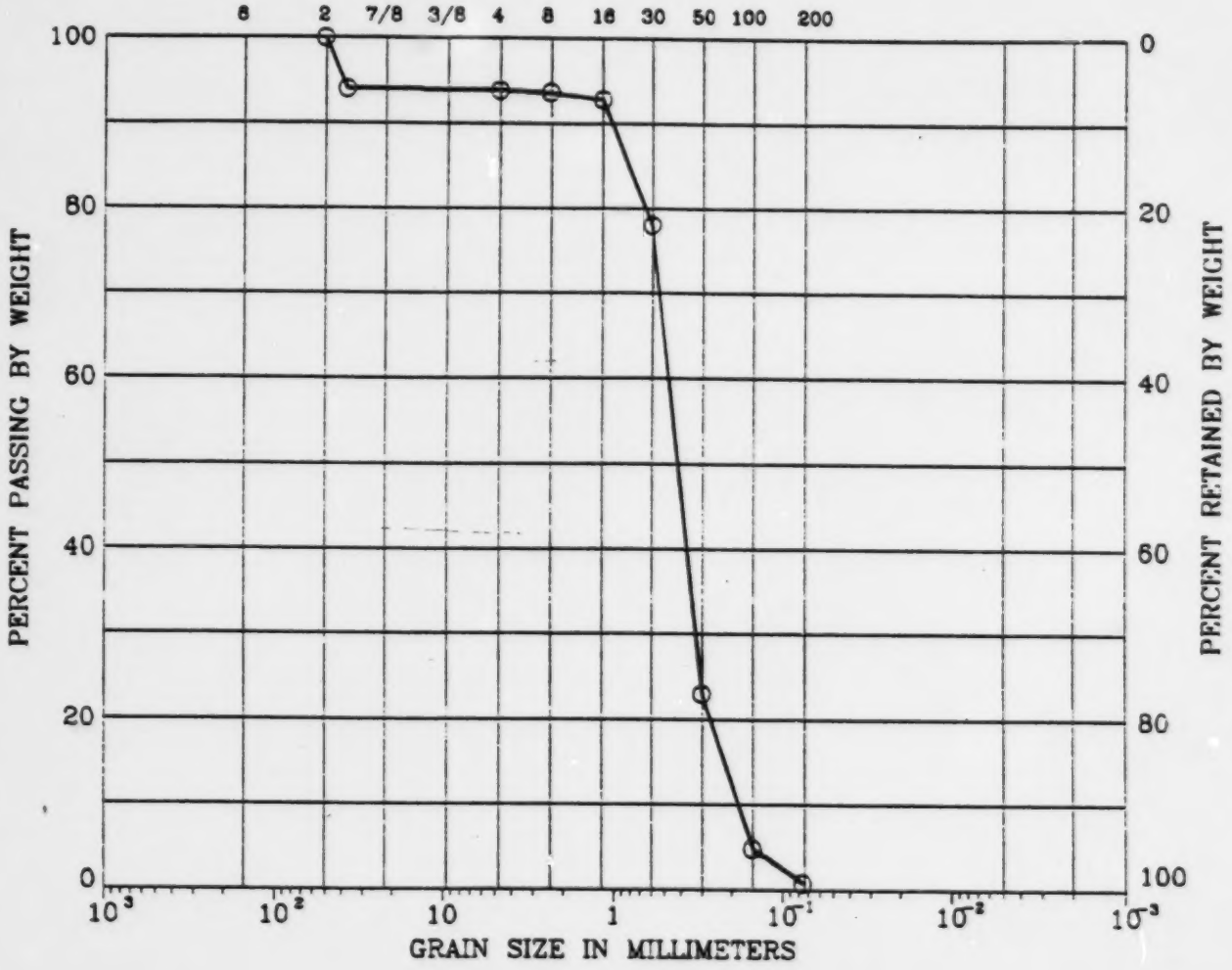
The results of the model are described elsewhere in this report (Section 5.2).

Appendix G

GRAIN SIZE ANALYSES

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



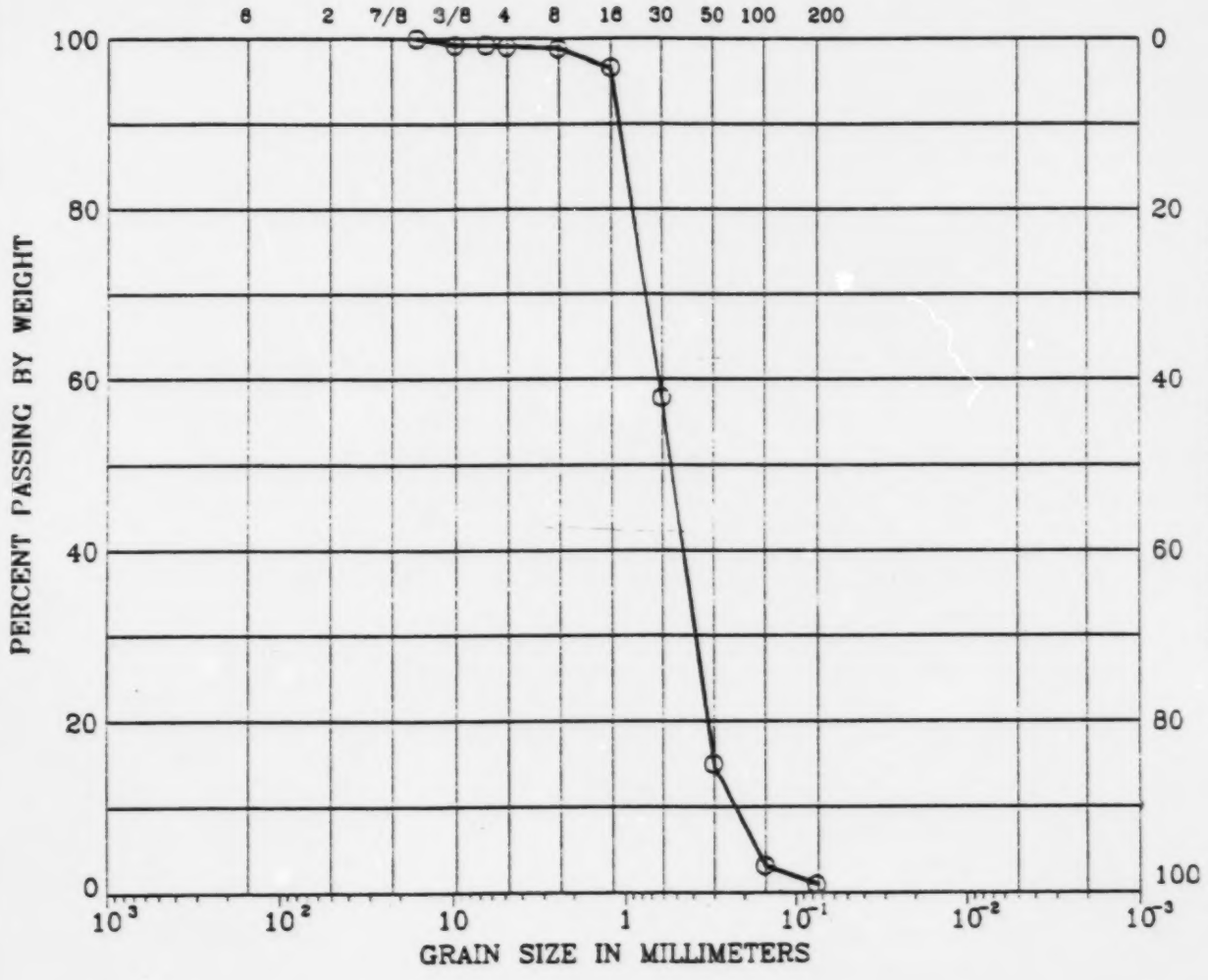
SYMBOL	BORING	DEPTH (m)	LL (%)	PI (%)	DESCRIPTION
O	-				FINE TO MEDIUM SAND, TRACE COARSE GRAVEL

Remark : SAMPLE: 6-SS4-BH S4

Project No. 90C247	SOUTH RIVER
ENE	GRAIN SIZE DISTRIBUTION Figure No. 1

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER


8 2 7/8 3/8 4 8 16 30 50 100 200
100 80 60 40 20 0
0 20 40 60 80 100
PERCENT PASSING BY WEIGHT
PERCENT RETAINED BY WEIGHT
10^3 10^2 10 1 10^{-1} 10^{-2} 10^{-3}
GRAIN SIZE IN MILLIMETERS

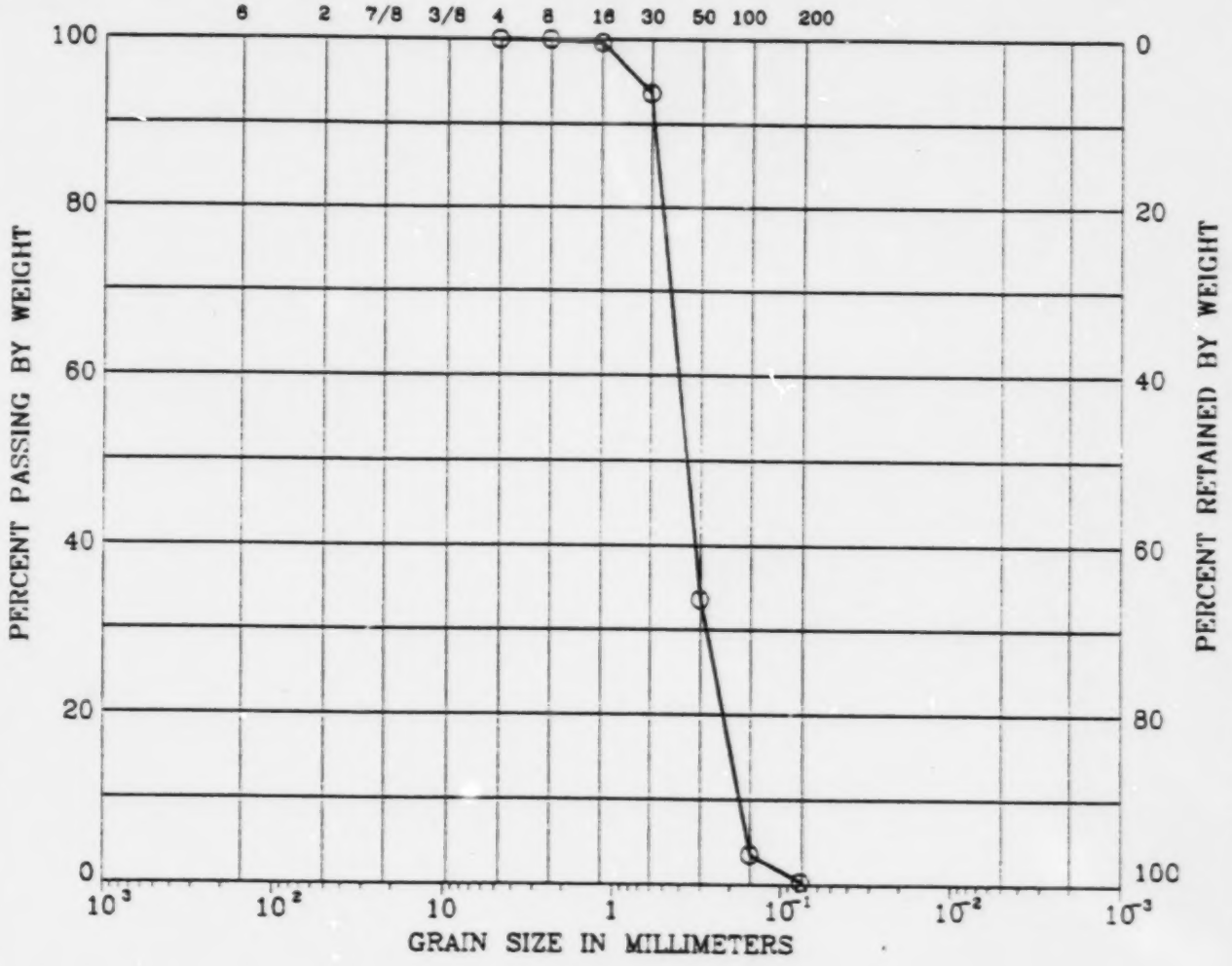
SYMBOL	BORING	DEPTH (m)	LL (%)	PI (%)	DESCRIPTION
O	-				FINE TO MEDIUM SAND, TRACE GRAVEL

Remark : SAMPLE: 14-SS8-S9

Project No. 90C247	SOUTH RIVER
ENE	GRAIN SIZE DISTRIBUTION Figure No. 2

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No.			HYDROMETER



SYMBOL	BORING	DEPTH (m)	LL (%)	PI (%)	DESCRIPTION
O	-				FINE TO MEDIUM SAND

Remark : SAMPLE: 15-SS3-SH1

Project No. 90C247	SOUTH RIVER
ENE	GRAIN SIZE DISTRIBUTION Figure No. 3

Appendix H

SUMMARY OF CCME GUIDELINES

TABLE 1: "ABC" VALUES FOR PAH IN SOIL AND GROUNDWATER AT COAL TAR WASTE SITES

PAH	Conc. in soil (mg/kg dry weight)			Conc. in Groundwater (ug/L)		
	A	B	C	A	B	C
Group 1 Carcinogenic PAH						
benzo(a)anthracene	0.1	1	10	0.01	0.1	1
benzo(b)fluoranthene	0.1	1	10	0.01	0.1	1
benzo(k)fluoranthene	0.1	1	10	0.01	0.1	1
benzo(a)pyrene	0.1	1	10	0.01	0.1	1
dibenz(a,h)anthracene	0.1	1	10	0.01	0.1	1
indeno(1,2,3-cd)pyrene	0.1	1	10	0.01	0.1	1
Group 2 Other PAH						
naphthalene	0.1	5	50	0.2	2	20
phenanthrene	0.1	5	50	0.2	2	20
pyrene	0.1	10	100	0.2	2	20

Value A: This value represents the approximate achievable detection limits for PAH in soil.
In groundwater, value A is based on drinking water criteria as described in the bold-faced paragraph on page 36.

Value A-B: The soil or groundwater is slightly contaminated. At this level of contamination, groundwater generally falls within the range of quality standards and criteria where they exist. However, it is worthwhile to investigate possible sources of contamination, especially in the case of groundwater to ascertain whether new contaminants continue to enter the water. This may lead to intervention focusing on the soil, particularly if the water is used for drinking. Usually at this level of soil or groundwater contamination, cleanup will not be necessary. However, should the land be redeveloped for especially sensitive purposes, e.g. residential or farming, it may be necessary to implement certain measures, such as the excavation of surficial layers of soil and/or the addition of a layer of clean oil.

Value B: This value is an intermediate value, approximately 5 to 10 times above value A.

Range B-C: The soil or groundwater is contaminated. At this level contamination of groundwater clearly exceeds drinking water standards where they exist and can no longer be used for that purpose.
Although the soil is contaminated, it will not automatically be cleaned up, unless the effect of contaminants on the groundwater necessitates such work.
However, restrictions on land use may be imposed when this level of contamination is observed in the soil. Restoration work may be necessary before the land is used for farming, residential or recreational purposes. Other less sensitive uses, e.g. industrial, commercial and so forth, may be contemplated without clean up being carried out. In all cases, the extent of the work required, e.g. the depth to which soil must be excavated and so on, will depend upon the nature of the contamination, ultimate land use and the impact on groundwater and the environment in general.

Value C: This value is considered to be the level at which contamination is significant.

Range Above C: The soil or groundwater is contaminated. Groundwater cannot be used for drinking. Unless the water is decontaminated, it will have to be monitored closely. Where the soil is contaminated, all uses of such land will be restricted. A thorough analysis must be conducted; in all likelihood, restoration will have to be undertaken before re-development occurs.

Taken from CCME (1989)

Appendix I

ANALYTICAL RESULTS, GROUNDWATER SAMPLES FROM MUNICIPAL WELLS #1 AND #2, NOVEMBER 1989

Environment Ontario

[redacted] REPORT

Page 1
Printed 18/12/89

Municipality/Project: SOUTH RIVER

Submission: W R 1 2 1 3 4

Sampling Date(s): N O V 1 6, 1 9 8 9

TA-0415-06

Program..... 0700801
Agency..... 0102011502

WATER TREATMENT RESEARCH
POLICY & ASSESSMENT UNIT

TECHNICAL ADVISORY

Sampled by: MATTHEW UZA

Date Submitted: 17/11/89,

Date Received: 17/11/89

..... Mail this copy to .....

PAWLOWSKI,I
WASTE MANAGEMENT
5th FLOOR, 40 ST CLAIR AVE W
TORONTO ONTARIO

Final reports to UZA,M.
PAWLOWSKI,I

WRB-DRINKING WATER
WASTE MANAGEMENT

Telephone: 416-235-5823
Telephone: 416-323-5183

Field Sample	Sampling Location	Sampling Location Description	Sampling Date	Sampling Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO. 1	16/11/89	13:35	5

Sample Description	Lab Sample#	Remarks	Lab Sample#	Remarks
RAW WATER	W47-0069 OW47-0077 MW47-0466		M47-0176 OP47-0089	

TESTS REQUESTED:

G+DWAPA	G+DWAPD
G+OPOPUP	G+OWOC
G+OWTRI	G+MBCOLI — [illegible]
G+OAPAHX	+CCNAUR
+HGUT	+PHNOL — [illegible]

Sample Class: M Results

Metals in Water ITC

Inquiries at: RAY McVICARS
Telephone: 416-235-5860

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO. 1 RAW WATER	M47-0176		16/11/89	13:35	5

Field Sample Number... 1

Test Description Code, Units of Measure	Method	M47-0176
URANIUM, UNF.TOTAL UUUT ,UG/L as U (Uranium)	001CE5	.06<T
COPPER, UNF.TOTAL. CUUT ,UG/L as Cu (Copper)	001CE5	.50<T
NICKEL, UNF.TOTAL NIUT ,UG/L as Ni (Nickel)	001CE5	<.10<W
LEAD, UNF.TOTAL PBUT ,UG/L as Pb (Lead)	001CE5	.07<T
ZINC, UNF.TOTAL ZNUT ,UG/L as Zn (Zinc)	001CE5	7.50
IRON, UNF.TOTAL FEUT ,UG/L as Fe (Iron)	001CE5	4200.00
MANGANESE, UNF.TOTAL MNUT ,UG/L as Mn Manganese	001CE5	76.00
SILVER, UNF.TOTAL AGUT ,UG/L as AG (SILVER)	001CE5	<.02<W
ALUMINUM, UNF.TOTAL ALUT ,UG/L as Al (Aluminum)	001CE5	13.00

Sample Class: M Results

Metals in Water ITC

Inquiries at: RAY McVICARS
Telephone: 416-235-5860

Test Description / Code, Units of Measure / Method	Field Sample Number... 1
	M47-0176
ARSENIC, UNF.TOTAL ASUT ,UG/L as As (Arsenic) 001CE5	<.05<W
BARIUM, UNF.TOTAL BAUT ,UG/L as BA (BARIUM) 001CE5	87.00
BORON, UNF.TOTAL BBUT ,UG/L as B (Boron) 001CE5	17.00<T
BERYLLIUM, UNF.TOTAL BEUT ,UG/L as BE (BERYLLIUM 001CE5	.03<T
CYANIDE,AVAIL.,UNF.REACT CCNAUR,MG/L as CN (Cyanide) 303AC2	<.001<W
CADMIUM, UNF.TOTAL CDUT ,UG/L as Cd (Cadmium) 001CE5	<.05<W
COBALT, UNF. TOTAL COUT ,UG/L as Co (Cobalt) 001CE5	.39<T
CHROMIUM, UNF.TOTAL CRUT ,UG/L as Cr (Chromium) 001CE5	.84<T
MERCURY, UNF.TOTAL HGUT ,UG/L as Hg (Mercury) 540AF1	<.01<W
MOLYBDENUM, UNF.TOTAL MOUT ,UG/L as Mo Molybdenum 001CE5	.07<T
ANTIMONY, UNF.TOTAL SBUT ,UG/L as Sb (Antimony) 001CE5	.31
SELENIUM, UNF.TOTAL SEUT ,UG/L as Se (Selenium) 001CE5	<1.00<W
STRONTIUM, UNF. TOTAL SRUT ,UG/L as SR (STRONTIUM 001CE5	53.00
TITANIUM, UNF.TOTAL TIUT ,UG/L as TI (TITANIUM) 001CE5	13.00
THALLIUM,UNF. TOTAL TLUT ,UG/L as TL (THALIUM) 001CE5	<.01<W

Sample Class: M Results

Metals in Water ITC

Inquiries at: RAY McVICARS
Telephone: 416-235-5860

Test Description / Code, Units of Measure / Method	Field Sample Number... 1
	M47-0176
VANADIUM,UNF,TOTAL VVUT ,UG/L as V (Vanadium) 001CE5	1.50

Sample Class: W Results

WATER (GRND/DOMESTIC) WQ

Inquiries at: MIKE RAWLINGS
Telephone: 416-235-5880

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO. 1 RAW WATER	W47-0069		16/11/89	13:35 5

Field Sample Number... 1

Test Description Code, Units of Measure / Method	W47-0069
CONDUCTIVITY 25C COND25,UMHO/CM at 25 D.CENT. 002BI2	105.
HARDNESS, TOTAL HARDT ,MG/L as CACO3 CALC01	19.7
CALCIUM, UNF.REACTIVE CAUR ,MG/L as Ca (Calcium) 002CA1	5.2
MAGNESIUM, UNF.REACTIVE MGUR ,MG/L as Mg Magnesium 001CA1	1.60
SODIUM, UNF.REACT. NAUR ,MG/L as Na (Sodium) 001EA1	8.8
ALKALINITY,TOTAL ALKT ,MG/L as CACO3 004AT6	12.8
PH (-LOG(H+(CONCN))) PH ,DIMENSIONLESS 003AI2	6.52
FLUORIDE, UNF.REACTIVE FFIDUR,MG/L as F (Fluoride) 003AC2	.04
CHLORIDE, UNF.REACTIVE CLIDUR,MG/L as Cl- Chloride 004BC2	15.20

Sample Class: W Results

WATER (GRND/DOMESTIC) WQ

Inquiries at: MIKE RAWLINGS
Telephone: 416-235-5880

Test Description / Code, Units of Measure / Method	Field Sample Number... 1
	W47-0069
SULPHATE, UNF.REACT. SSO4UR,MG/L as SO4 Sulphate 003AI0	4.73
TURBIDITY TURB ,FORMAZIN TURB. UNITS 002AI1	7.20
COLOUR, TRUE COLTR ,TRUE COLOUR UNITS 102BC9	39.5
PHOSPHORUS, UNF.TOTAL PPUT ,MG/L as P Phosphorus 504AC2	<.002<W
PHOSPHATES, FRAC.REACT. PPO4FR,MG/L as P Phosphorus 103DC2	<.0005<W
NITR'N,TOTAL KJELD,UNF.R NNTKUR,MG/L as N (Nitrogen) 004AC2	.230
AMMONIUM,TOTL, FRAC.REAC NNHTFR,MG/L as N (Nitrogen) 103DC2	.106
NITRATES,TOTL, FRAC.REAC NNOTFR,MG/L as N (Nitrogen) 102DC2	1.700
NITRITE, FRAC.REACT. NNO2FR,MG/L as N (Nitrogen) 102DC2	.0070
PHENOLICS (UNF.REACTIVE) PHNOL ,UG/L as PHENOL 002BC2	<.2<W

Sample Class: ## Results

DERIVED RESULTS

Inquiries at: WATER QUALITY OFFICE
Telephone: 416-248-3512

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO. 1 RAW WATER	DR-CAL		16/11/89	13:35	5

Field Sample Number... 1

Test Description Code, Units of Measure / Method	DR-CAL
LANGELIER'S INDEX LANGI ,	-3.0

Sample Class: MW Results

DOMESTIC WATER MICROBIOL

Inquiries at: STEVE DEBRECENI/ROSA LEE
Telephone: 416-235-6011

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO. 1 RAW WATER	MW47-0466		16/11/89	13:35	5

Field Sample Number... 1

Test Description Code, Units of Measure / Method	MW47-0466
TOTAL COLIFORM MF TCMF ,COUNTS/100 MILLILITRE LF 22	0.
TOTAL COLIFORM MF BKGD TCMFBK,COUNTS/100 MILLILITRE LF 22	0.
FECAL COLIFORM MF FCMF ,COUNTS/100 MILLILITRE TF1 24	0.

Sample Class: OP Results

PRIORITY ORGANICS DWO

Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO. 1 RAW WATER	OP47-0089		16/11/89	13:35	5

Field Sample Number... 1

Test Description Code, Units of Measure / Method	OP47-0089
1,1-DICHLOROETHYLENE X1001P,UG/L Microgram/Litre P0C0D0	<.1<W
DICHLOROMETHANE X1002P,UG/L Microgram/Litre P0C0D0	<.5<W
TRS-1,2-DICHLOROETHYLENE X1003P,UG/L Microgram/Litre P0C0D0	<.1<W
1,1-DICHLOROETHANE X1004P,UG/L Microgram/Litre P0C0D0	<.1<W
CHLOROFORM X1005P,UG/L Microgram/Litre P0C0D0	<.1<W
1,1,1-TRICHLOROETHANE X1006P,UG/L Microgram/Litre P0C0D0	<.02<W
1,2-DICHLOROETHANE X1007P,UG/L Microgram/Litre P0C0D0	<.05<W
CARBONTETRACHLORIDE X1008P,UG/L Microgram/Litre P0C0D0	<.2<W
BENZENE B2001P,UG/L Microgram/Litre P0C0D0	.05<T

Sample Class: OP Results

PRIORITY ORGANICS DWO

Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Test Description / Code, Units of Measure / Method	Field Sample Number... 1 OP47-0089
1,2-DICHLOROPROPANE X1009P,UG/L Microgram/Litre P0C0D0	<.05<W
TRICHLOROETHYLENE X1010P,UG/L Microgram/Litre P0C0D0	<.1<W
DICHLOROBROMOMETHANE X1011P,UG/L Microgram/Litre P0C0D0	<.05<W
TOLUENE B2002P,UG/L Microgram/Litre P0C0D0	<.05<W
1,1,2-TRICHLOROETHANE X1012P,UG/L Microgram/Litre P0C0D0	<.05<W
CHLORODIBROMOMETHANE X1013P,UG/L Microgram/Litre P0C0D0	<.1<W
TETRACHLOROETHYLENE X1014P,UG/L Microgram/Litre P0C0D0	<.05<W
CHLOROBENZENE X2001P,UG/L Microgram/Litre P0C0D0	<.1<W
TOTAL TRIHALOMETHANES X2TTHM,UG/L Microgram/Litre P0C0D0	<.50<W
ETHYLBENZENE B2003P,UG/L Microgram/Litre P0C0D0	<.05<W
ETHYLENE DIBROMIDE X2EDB ,UG/L Microgram/Litre P0C0D0	<.05<W
P-XYLENE B2004P,UG/L Microgram/Litre P0C0D0	<.1<W
M-XYLENE B2005P,UG/L Microgram/Litre P0C0D0	<.1<W
BROMOFORM X1015P,UG/L Microgram/Litre P0C0D0	<.2<W
O-XYLENE B2006P,UG/L Microgram/Litre P0C0D0	<.05<W

Sample Class: OP Results

PRIORITY ORGANICS DWO

Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Test Description / Code, Units of Measure / Method	Field Sample Number... 1
	OP47-0089
1,1,2,2TETRACHLOROETHANE X1016P,UG/L Microgram/Litre P0C0D0	<.05<W APS
1,4-DICHLOROBENZENE X2002P,UG/L Microgram/Litre P0C0D0	<.1<W
1,3-DICHLOROBENZENE X2003P,UG/L Microgram/Litre P0C0D0	<.1<W
1,2-DICHLOROBENZENE X2004P,UG/L Microgram/Litre P0C0D0	<.05<W
STYRENE B2008P,UG/L Microgram/Litre P0C0D0	<.05<W

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO. 1 RAW WATER	OW47-0077		16/11/89	13:35	5

Field Sample Number... 1

Test Code, Units of Measure	Description / Method	OW47-0077
AMETRYNE P2AMET,NG/L	(Nanogram/Litre) W0IP3V	<50.<W
PROMETONE P2PROM,NG/L	(Nanogram/Litre) W0IP3V	<50.<W
PROPAZINE P2PROP,NG/L	(Nanogram/Litre) W0IP3V	<50.<W
ATRAZINE P2ATRA,NG/L	(Nanogram/Litre) W0IP3V	<50.<W
PROMETRYNE P2PROY,NG/L	(Nanogram/Litre) W0IP3V	<50.<W
SIMAZINE P2SIM ,NG/L	(Nanogram/Litre) W0IP3V	<50.<W
SENCOR P2SENC,NG/L	(Nanogram/Litre) W0IP3V	<100.<W
BLADEX P2BLAD,NG/L	(Nanogram/Litre) W0IP3V	<100.<W
ATRATONE P2ATRO,NG/L	(Nanogram/Litre) W0IP3V	<50.<W

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description / Code, Units of Measure / Method	Field Sample Number... 1 OW47-0077
DETHYLATED ATRAZINE P2DATR,NG/L (Nanogram/Litre) W01P3V	<200. <W
METALACHLOR POMET ,NG/L (Nanogram/Litre) W01P3V	<500. <W
LASSO POLASS,NG/L (Nanogram/Litre) W01P3V	<500. <W
DIETHYL SIMAZINE P2DSIM,NG/L (Nanogram/Litre) W01P3V	<200. <W
HEXACHLOROETHANE X2HCE ,NG/L (Nanogram/Litre) W04B1X	<1. <W
135-TRICHLOROBENZENE X2135 ,NG/L (Nanogram/Litre) W04B1X	<5. <W
124TRICHLOROBENZENE X2124 ,NG/L (Nanogram/Litre) W04B1X	<5. <W
HEXACHLOROBUTADIENE X1HCBD,NG/L (Nanogram/Litre) W04B1X	<1. <W
123TRICHLOROBENZENE X2123 ,NG/L (Nanogram/Litre) W04B1X	<5. <W
2,4,5-TRICHLOROTOLUENE X2T245,NG/L (Nanogram/Litre) W04B1X	<5. <W
2,3,6-TRICHLOROTOLUENE X2T236,NG/L (Nanogram/Litre) W04B1X	<5. <W
1235TETRACHLOROBENZENE X21235,NG/L (Nanogram/Litre) W04B1X	<1. <W
1245 TETRACHLOROBENZENE X21245,NG/L (Nanogram/Litre) W04B1X	<1. <W
2,6,a-TRICHLOROTOLUENE X2T26A,NG/L (Nanogram/Litre) W04B1X	<5. <W
1234TETRACHLOROBENZENE X21234,NG/L (Nanogram/Litre) W04B1X	<1. <W

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description Code, Units of Measure Method	Field Sample Number... 1 OW47-0077
PENTACHLOROBENZENE X2PNCB,NG/L (Nanogram/Litre) W04B1X	<1. <W
PCB, TOTAL P1PCBT,NG/L (Nanogram/Litre) W04B1X	<20. <W
HEXACHLOROBENZENE X2HCB ,NG/L (Nanogram/Litre) W04B1X	<1. <W
HEPTACHLOR P1HEPT,NG/L (Nanogram/Litre) W04B1X	<1. <W
ALDRIN P1ALDR,NG/L (Nanogram/Litre) W04B1X	<1. <W
PP-DDE P1PPDE,NG/L (Nanogram/Litre) W04B1X	<1. <W
MIREX P1MIRX,NG/L (Nanogram/Litre) W04B1X	<5. <W
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/L (Nanogram/Litre) W04B1X	<1. <W
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/L (Nanogram/Litre) W04B1X	<1. <W
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/L (Nanogram/Litre) W04B1X	<1. <W
A-CHLORDANE P1CHLA,NG/L (Nanogram/Litre) W04B1X	<2. <W
G-CHLORDANE P1CHLG,NG/L (Nanogram/Litre) W04B1X	<2. <W
OXYCHLORDANE P1OCHL,NG/L (Nanogram/Litre) W04B1X	<2. <W
OP-DDT P1OPDT,NG/L (Nanogram/Litre) W04B1X	<5. <W
PP-DDD P1PPDD,NG/L (Nanogram/Litre) W04B1X	<5. <W

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description / Code, Units of Measure / Method	Field Sample Number... 1				
	OW47-0077				
PP-DDT P1PPDT,NG/L (Nanogram/Litre) W04B1X	<5.<W				
DMDT METHOXYCHLOR P1DMDT,NG/L (Nanogram/Litre) W04B1X	<5.<W				
HEPTACHLOREPOXIDE P1HEPE,NG/L (Nanogram/Litre) W04B1X	<1.<W				
ENDOSULFAN I P1END1,NG/L (Nanogram/Litre) W04B1X	<2.<W				
DIELDRIN P1DIEL,NG/L (Nanogram/Litre) W04B1X	<2.<W				
ENDRIN P1ENDR,NG/L (Nanogram/Litre) W04B1X	<5.<W				
ENDOSULFAN II P1END2,NG/L (Nanogram/Litre) W04B1X	<5.<W				
ENDOSULFAN SULPHATE P1ENDS,NG/L (Nanogram/Litre) W04B1X	<5.<W				
OCTACHOROSTYRENE X20CST,NG/L (Nanogram/Litre) W04B1X	<1.<W				
TOXAPHENE P1TOX ,NG/L (Nanogram/Litre) W04B1X	<500.<W				
PHENANTHRENE B3001X,NG/L (Nanogram/Litre) X3H1D1	<10.<W				
ANTHRACENE B3002X,NG/L (Nanogram/Litre) X3H1D1	<1.<W				
FLUORANTHENE B3003X,NG/L (Nanogram/Litre) X3H1D1	<20.<W				
PYRENE B3004X,NG/L (Nanogram/Litre) X3H1D1	<20.<W				
BENZ(A)ANTHRACENE B3005X,NG/L (Nanogram/Litre) X3H1D1	<20.<W				

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description Code, Units of Measure Method	Field Sample Number... 1 OW47-0077
CHRYSENE B3006X,NG/L (Nanogram/Litre) X3H1D1	<50. W
DIMETH.BENZ(A)ANTHRACENE B3007X,NG/L (Nanogram/Litre) X3H1D1	<5. W
BENZO(E)PYRENE B3008X,NG/L (Nanogram/Litre) X3H1D1	<50. W
BENZO(B)FLUORANTHENE B3010X,NG/L (Nanogram/Litre) X3H1D1	<10. W
PERYLENE B3011X,NG/L (Nanogram/Litre) X3H1D1	<10. W
BENZO(K)FLUORANTHENE B3012X,NG/L (Nanogram/Litre) X3H1D1	<1. W
BENZO(A)PYRENE B3013X,NG/L (Nanogram/Litre) X3H1D1	<5. W
BENZO(G,H,I)PERYLENE B3014X,NG/L (Nanogram/Litre) X3H1D1	<20. W
DIBENZ(A,H)ANTHRACENE B3015X,NG/L (Nanogram/Litre) X3H1D1	<10. W
INDENO(1,2,3-C,D)PYRENE B3016X,NG/L (Nanogram/Litre) X3H1D1	<20. W
BENZO(B)CHRYSENE B3017X,NG/L (Nanogram/Litre) X3H1D1	<2. W
CORONENE B3019X,NG/L (Nanogram/Litre) X3H1D1	<10. W

REMARK CODE EXPLANATIONS

RMK	DESCRIPTION
<T	A MEASURABLE TRACE AMOUNT:INTERPRET WITH CAUTION
<W	NO MEASURABLE RESPONSE (ZERO): (REPORTED VALUE
APS	ADDITIONAL PEAK,SMALL,NOT PRIORITY POLLUTANT

*** END OF REPORT ***

Environment Ontario

Printed 18/12/89

Municipality/Project: SOUTH RIVER

Submission: WR12135

Sampling Date(s): NOV 16, 1989

TA-04-15-06

Program..... 0700801
Agency..... 0102011502

WATER TREATMENT RESEARCH POLICY & ASSESSMENT UNIT TECHNICAL ADVISORY

Sampled by: MATTHEW UZA

Date Submitted: 17/11/89, Date Received: 17/11/89

..... Mail this copy to .....

PAWLOWSKI,I
WASTE MANAGEMENT
5th FLOOR, 40 ST CLAIR AVE W
TORONTO ONTARIO

Final reports to UZA,M. WRB-DRINKING WATER Telephone: 416-235-5823
PAWLOWSKI,I WASTE MANAGEMENT Telephone: 416-323-5183

Field Sample	Sampling Location	Sampling Location Description	Sampling Date	Time	Zone
.1	CODE NOT GIVEN	SOUTH RIVER WELL NO.2	16/11/89	14:00	5

Sample Description	Lab Sample#	Remarks	Lab Sample#	Remarks
RAW WATER	W47-0067 OW47-0075 MW47-0464		M47-0174 OP47-0087	

TESTS REQUESTED:

G+DWAPA	G+DWAPD
G+OPOPUP	G+OWOC
G+OWTRI	G+MBCOLI
G+OAPAHX	+CCNAUR
+HGUT	+PHNOL

Sample Class: M Results

Metals in Water ITC

Inquiries at: RAY McVICAR8
Telephone: 416-235-5860

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO.2 RAW WATER	M47-0174		16/11/89	14:00	5

Field Sample Number... 1

Test Description Code, Units of Measure / Method	M47-0174
URANIUM, UNF.TOTAL UUUT ,UG/L as U (Uranium) 001CE5	.03<T
COPPER, UNF.TOTAL. CUUT ,UG/L as Cu (Copper) 001CE5	.40<T
NICKEL, UNF.TOTAL NIUT ,UG/L as Ni (Nickel) 001CE5	.11<T
LEAD, UNF.TOTAL PBUT ,UG/L as Pb (Lead) 001CE5	.07<T
ZINC, UNF.TOTAL ZNUT ,UG/L as Zn (Zinc) 001CE5	6.00
IRON, UNF.TOTAL FEUT ,UG/L as Fe (Iron) 001CE5	3000.00
MANGANESE, UNF.TOTAL MNUT ,UG/L as Mn Manganese 001CE5	120.00
SILVER, UNF TOTAL AGUT ,UG/L as AG (SILVER) 001CE5	<.02<W
ALUMINUM, UNF.TOTAL ALUT ,UG/L as Al (Aluminum) 001CE5	13.00

Sample Class: M Results

Metals in Water ITC

Inquiries at: RAY McVICARS
Telephone: 416-235-5860

Test Description / Code, Units of Measure / Method	Field Sample Number... 1
	M47-0174
ARSENIC, UNF.TOTAL ASUT ,UG/L as As (Arsenic) 001CE5	<.05<W
BARIUM, UNF.TOTAL BAUT ,UG/L as BA (BARIUM) 001CE5	71.00
BORON, UNF.TOTAL BBUT ,UG/L as B (Boron) 001CE5	18.00<T
BERYLLIUM, UNF.TOTAL BEUT ,UG/L as BE (BERYLLIUM 001CE5	<.01<W
CYANIDE,AVAIL.,UNF.REACT CCNAUR,MG/L as CN (Cyanide) 303AC2	<.001<W
CADMIUM, UNF.TOTAL CDUT ,UG/L as Cd (Cadmium) 001CE5	<.05<W
COBALT, UNF. TOTAL COUT ,UG/L as Co (Cobalt) 001CE5	.47<T
CHROMIUM, UNF.TOTAL CRUT ,UG/L as Cr (Chromium) 001CE5	.52<T
MERCURY, UNF.TOTAL HGUT ,UG/L as Hg (Mercury) 540AF1	<.01<W
MOLYBDENUM, UNF.TOTAL MOUT ,UG/L as Mo Molybdenum 001CE5	<.02<W
ANTIMONY, UNF.TOTAL SBUT ,UG/L as Sb (Antimony) 001CE5	.29
SELENIUM, UNF.TOTAL SEUT ,UG/L as Se (Selenium) 001CE5	<1.00<W
STRONTIUM, UNF. TOTAL SRUT ,UG/L as SR (STRONTIUM 001CE5	49.00
TITANIUM, UNF.TOTAL TIUT ,UG/L as TI (TITANIUM) 001CE5	10.00
THALLIUM,UNF.TOTAL TLUT ,UG/L as TL (THALIUM) 001CE5	<.01<W

Sample Class: M Results

Metals in Water ITC

Inquiries at: RAY McVICARS
Telephone: 416-235-5860

Test Description / Code, Units of Measure / Method	Field Sample Number... 1 M47-0174
VANADIUM,UNF,TOTAL VVUT ,UG/L as V (Vanadium) 001CES	.43<T

Sample Class: W Results

WATER (GRND/DOMESTIC) WQ

Inquiries at: MIKE RAWLINGS
Telephone:.416-235-5880

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO.2 RAW WATER	W47-0067		16/11/89	14:00	5

Field Sample Number... 1

Test Description Code, Units of Measure / Method	W47-0067
CONDUCTIVITY 25C COND25,UMHO/CM at 25 D.CENT. 002BI2	101.
HARDNESS, TOTAL HARDT ,MG/L as CACO3 CALC01	20.2
CALCIUM, UNF.REACTIVE CAUR ,MG/L as Ca (Calcium) 002CA1	5.4
MAGNESIUM, UNF.REACTIVE MGUR ,MG/L as Mg Magnesium 001CA1	1.65
SODIUM, UNF.REACT. NAUR ,MG/L as Na (Sodium) 001EA1	7.4
ALKALINITY,TOTAL ALKT ,MG/L as CACO3 004AT6	9.3
PH (-LOG(H+(CONCN))) PH ,DIMENSIONLESS 003AI2	6.55
FLUORIDE, UNF.REACTIVE FFIDUR,MG/L as F (Fluoride) 003AC2	.04
CHLORIDE, UNF.REACTIVE CLIDUR,MG/L as Cl- Chloride 004BC2	15.90

Sample Class: W Results

WATER (GRND/DOMESTIC) WQ

Inquiries at: MIKE RAWLINGS
Telephone: 416-235-5880

Field Sample Number...	1
Test Description / Code, Units of Measure / Method	W47-0067
SULPHATE, UNF.REACT. SSO4UR,MG/L as SO4 Sulphate 003AI0	7.82
TURBIDITY TURB ,FORMAZIN TURB. UNITS 002AI1	4.90
COLOUR, TRUE COLTR ,TRUE COLOUR UNITS 102BC9	50.5
PHOSPHORUS, UNF.TOTAL PPUT ,MG/L as P Phosphorus 504AC2	<.002<W
PHOSPHATES, FRAC.REACT. PPO4FR,MG/L as P Phosphorus 103DC2	<.0005<W
NITR'N,TOTAL KJELD,UNF.R NNTKUR,MG/L as N (Nitrogen) 004AC2	.100
AMMONIUM,TOTL, FRAC.REAC NNHTFR,MG/L as N (Nitrogen) 103DC2	.044
NITRATES,TOTL, FRAC.REAC NNOTFR,MG/L as N (Nitrogen) 102DC2	1.120
NITRITE, FRAC.REACT. NNO2FR,MG/L as N (Nitrogen) 102DC2	.0070
PHENOLICS (UNF.REACTIVE) PHNOL ,UG/L as PHENOL 002BC2	.6<T

Sample Class: ## Results

DERIVED RESULTS

Inquiries at: WATER QUALITY OFFICE
Telephone: 416-248-3512

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO.2 RAW WATER	DR-CAL		16/11/89	14:00	5

Field Sample Number... 1

Test Description / Code, Units of Measure / Method	DR-CAL
LANGELIER'S INDEX LANGI ,	-3.1

Sample Class: MW Results

DOMESTIC WATER MICROBIOL

Inquiries at: STEVE DEBRECENI/ROSA LEE
Telephone: 416-235-6011

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO.2 RAW WATER	MW47-0464		16/11/89	14:00	5

Field Sample Number... 1

Test Description Code, Units of Measure / Method	MW47-0464
TOTAL COLIFORM MF TCMF ,COUNTS/100 MILLILITRE LF 22	0.
TOTAL COLIFORM MF BKGD TCMFBK,COUNTS/100 MILLILITRE LF 22	0.
FECAL COLIFORM MF FCMF ,COUNTS/100 MILLILITRE TF1 24	0.

Sample Class: OP Results

PRIORITY ORGANICS DWO

Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO.2 RAW WATER	OP47-0087		16/11/89	14:00	5

Field Sample Number... 1

Test Description Code, Units of Measure / Method	OP47-0087				
1,1-DICHLOROETHYLENE X1001P,No Units available	!LA				
DICHLOROMETHANE X1002P,No Units available	!LA				
TRS-1,2-DICHLOROETHYLENE X1003P,No Units available	!LA				
1,1-DICHLOROETHANE X1004P,No Units available	!LA				
CHLOROFORM X1005P,No Units available	!LA				
1,1,1-TRICHLOROETHANE X1006P,No Units available	!LA				
1,2-DICHLOROETHANE X1007P,No Units available	!LA				
CARBONTETRACHLORIDE X1008P,No Units available	!LA				
BENZENE B2001P,No Units available	!LA				

Sample Class: OP Results

PRIORITY ORGANICS DWO Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Test Description Code, Units of Measure Method	Field Sample Number...				
	1				
	OP47-0087				
1,2-DICHLOROPROPANE X1009P,No Units available	!LA				
TRICHLOROETHYLENE X1010P,No Units available	!LA				
DICHLOROBROMOMETHANE X1011P,No Units available	!LA				
TOLUENE B2002P,No Units available	!LA				
1,1,2-TRICHLOROETHANE X1012P,No Units available	!LA				
CHLORODIBROMOMETHANE X1013P,No Units available	!LA				
TETRACHLOROETHYLENE X1014P,No Units available	!LA				
CHLOROBENZENE X2001P,No Units available	!LA				
TOTAL TRIHALOMETHANES X2TTHM,No Units available	!LA				
ETHYLBENZENE B2003P,No Units available	!LA				
ETHYLENE DIBROMIDE X2EDB ,No Units available	!LA				
P-XYLENE B2004P,No Units available	!LA				
M-XYLENE B2005P,No Units available	!LA				
BROMOFORM X1015P,No Units available	!LA				
O-XYLENE B2006P,No Units available	!LA				

Sample Class: OP Results

PRIORITY ORGANICS DWO

Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Test Description Code, Units of Measure Method	Field Sample Number... 1 OP47-0087				
1,1,2,2TETRACHLOROETHANE X1016P,No Units available	!LA				
1,4-DICHLOROBENZENE X2002P,No Units available	!LA				
1,3-DICHLOROBENZENE X2003P,No Units available	!LA				
1,2-DICHLOROBENZENE X2004P,No Units available	!LA				
STYRENE B2008P,No Units available	!LA				

Sample Class: OW

Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
1	CODE NOT GIVEN	SOUTH RIVER WELL NO.2 RAW WATER	OW47-0075		16/11/89	14:00	5

Field Sample Number... 1

Test Description Code, Units of Measure	Method	OW47-0075
AMETRYNE P2AMET,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
PROMETONE P2PROM,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
PROPAZINE P2PROP,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
ATRAZINE P2ATRA,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
PROMETRYNE P2PROY,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
SIMAZINE P2SIM ,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
SENCOR P2SENC,NG/L (Nanogram/Litre)	W0IP3V	<100.<W
BLADEX P2BLAD,NG/L (Nanogram/Litre)	W0IP3V	<100.<W
ATRATONE P2ATRO,NG/L (Nanogram/Litre)	W0IP3V	<50.<W

Sample Class: OW

Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Field Sample Number...	1
Test Description / Code, Units of Measure / Method	OW47-0075
DETHYLATED ATRAZINE · P2DATR,NG/L (Nanogram/Litre) W0IP3V	<200.<W
METALACHLOR POMET ,NG/L (Nanogram/Litre) W0IP3V	<500.<W
LASSO POLASS,NG/L (Nanogram/Litre) W0IP3V	<500.<W
DIETHYL SIMAZINE P2DSIM,NG/L (Nanogram/Litre) W0IP3V	<200.<W
HEXACHLOROETHANE X2HCE ,NG/L (Nanogram/Litre) W04B1X	<1.<W
135-TRICHLOROBENZENE X2135 ,NG/L (Nanogram/Litre) W04B1X	<5.<W
124TRICHLOROBENZENE X2124 ,NG/L (Nanogram/Litre) W04B1X	<5.<W
HEXACHLOROBUTADIENE X1HCBD,NG/L (Nanogram/Litre) W04B1X	<1.<W
123TRICHLOROBENZENE X2123 ,NG/L (Nanogram/Litre) W04B1X	<5.<W
2,4,5-TRICHLOROTOLUENE X2T245,NG/L (Nanogram/Litre) W04B1X	<5.<W
2,3,6-TRICHLOROTOLUENE X2T236,NG/L (Nanogram/Litre) W04B1X	<5.<W
1235TETRACHLOROBENZENE X21235,NG/L (Nanogram/Litre) W04B1X	<1.<W
1245 TETRACHLOROBENZENE X21245,NG/L (Nanogram/Litre) W04B1X	<1.<W
2,6,a-TRICHLOROTOLUENE X2T26A,NG/L (Nanogram/Litre) W04B1X	<5.<W
1234TETRACHLOROBENZENE X21234,NG/L (Nanogram/Litre) W04B1X	<1.<W

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description / Code, Units of Measure / Method	Field Sample Number... 1 OW47-0075					
PENTACHLOROBENZENE X2PNCB,NG/L (Nanogram/Litre) W04B1X	<1.	<W				
PCB, TOTAL P1PCBT,NG/L (Nanogram/Litre) W04B1X	<20.	<W				
HEXACHLOROBENZENE X2HCB ,NG/L (Nanogram/Litre) W04B1X	<1.	<W				
HEPTACHLOR P1HEPT,NG/L (Nanogram/Litre) W04B1X	<1.	<W				
ALDRIN P1ALDR,NG/L (Nanogram/Litre) W04B1X	<1.	<W				
PP-DDE P1PPDE,NG/L (Nanogram/Litre) W04B1X	<1.	<W				
MIREX P1MIRX,NG/L (Nanogram/Litre) W04B1X	<5.	<W				
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/L (Nanogram/Litre) W04B1X	<1.	<W				
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/L (Nanogram/Litre) W04B1X	<1.	<W				
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/L (Nanogram/Litre) W04B1X	<1.	<W				
A-CHLORDANE P1CHLA,NG/L (Nanogram/Litre) W04B1X	<2.	<W				
G-CHLORDANE P1CHLG,NG/L (Nanogram/Litre) W04B1X	<2.	<W				
OXYCHLORDANE P1OCHL,NG/L (Nanogram/Litre) W04B1X	<2.	<W				
OP-DDT P1OPDT,NG/L (Nanogram/Litre) W04B1X	<5.	<W				
PP-DDD P1PPDD,NG/L (Nanogram/Litre) W04B1X	<5	<W				

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description / Code, Units of Measure / Method	Field Sample Number... 1 OW47-0075
PP-DDT P1PPDT,NG/L (Nanogram/Litre) W04B1X	<5.<W
DMDT METHOXYCHLOR P1DMDT,NG/L (Nanogram/Litre) W04B1X	<5.<W
HEPTACHLOREPOXIDE P1HEPE,NG/L (Nanogram/Litre) W04B1X	<1.<W
ENDOSULFAN I P1END1,NG/L (Nanogram/Litre) W04B1X	<2.<W
DIELDRIN P1DIEL,NG/L (Nanogram/Litre) W04B1X	<2.<W
ENDRIN P1ENDR,NG/L (Nanogram/Litre) W04B1X	<5.<W
ENDOSULFAN II P1END2,NG/L (Nanogram/Litre) W04B1X	<5.<W
ENDOSULFAN SULPHATE P1ENDS,NG/L (Nanogram/Litre) W04B1X	<5.<W
OCTACHOROSTYRENE X20CST,NG/L (Nanogram/Litre) W04B1X	<1.<W
TOXAPHENE P1TOX ,NG/L (Nanogram/Litre) W04B1X	<500.<W
PHENANTHRENE B3001X,NG/L (Nanogram/Litre) X3H1D1	<10.<W
ANTHRACENE B3002X,NG/L (Nanogram/Litre) X3H1D1	<1.<W
FLUORANTHENE B3003X,NG/L (Nanogram/Litre) X3H1D1	<20.<W
PYRENE B3004X,NG/L (Nanogram/Litre) X3H1D1	<20.<W
BENZ(A)ANTHRACENE B3005X,NG/L (Nanogram/Litre) X3H1D1	<20.<W

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description / Code, Units of Measure / Method	Field Sample Number... 1 — OW47-0075
CHRYSENE B3006X,NG/L (Nanogram/Litre) X3H1D1	<50.<W
DIMETH.BENZ(A)ANTHRACENE B3007X,NG/L (Nanogram/Litre) X3H1D1	<5.<W
BENZO(E)PYRENE B3008X,NG/L (Nanogram/Litre) X3H1D1	<50.<W
BENZO(B)FLUORANTHENE B3010X,NG/L (Nanogram/Litre) X3H1D1	<10.<W
PERYLENE B3011X,NG/L (Nanogram/Litre) X3H1D1	<10.<W
BENZO(K)FLUORANTHENE B3012X,NG/L (Nanogram/Litre) X3H1D1	<1.<W
BENZO(A)PYRENE B3013X,NG/L (Nanogram/Litre) X3H1D1	<5.<W
BENZO(G,H,I)PERYLENE B3014X,NG/L (Nanogram/Litre) X3H1D1	<20.<W
DIBENZ(A,H)ANTHRACENE B3015X,NG/L (Nanogram/Litre) X3H1D1	<10.<W
INDENO(1,2,3-C,D)PYRENE B3016X,NG/L (Nanogram/Litre) X3H1D1	<20.<W
BENZO(B)CHRYSENE B3017X,NG/L (Nanogram/Litre) X3H1D1	<2.<W
CORONENE B3019X,NG/L (Nanogram/Litre) X3H1D1	<10.<W

REMARK CODE EXPLANATIONS

RMK	DESCRIPTION
!LA	NO DATA: SAMPLE SPOILED IN LABORATORY ACCIDENT.
<T	A MEASURABLE TRACE AMOUNT: INTERPRET WITH CAUTION
<W	NO MEASURABLE RESPONSE (ZERO): <REPORTED VALUE

*** END OF REPORT ***

Environment Ontario
FINAL REPORT

Printed 15/01/90

Municipality/Project: S O U T H R I V E R

Submission: W R 1 2 1 3 1

Sampling Date(s): N O V 1 6, 1 9 8 9

90 JAN 31 P2 :29
WASTE MANAGEMENT

Program..... 0700801
Agency..... 0102011502

WATER TREATMENT RESEARCH TECHNICAL ADVISORY
POLICY & ASSESSMENT UNIT

Sampled by: MATTHEW UZA

Date Submitted: 17/11/89, Date Received: 17/11/89

..... Mail this copy to ..... UZA,M.
WRB-DRINKING WATER
125 RESOURCES RD.RM.E-252
REXDALE ONTARIO
M9W 5L1

Final reports to UZA,M. WRB-DRINKING WATER Telephone: 416-235-5823
PAWLOWSKI,I WASTE MANAGEMENT Telephone: 416-323-5183

Field Sample	Sampling Location	Sampling Location Description	Sampling Date	Time	Zone
2	CODE NOT GIVEN	SOUTH RIVER	16/11/89	14:30	5

Sample Description	Lab Sample#	Remarks	Lab Sample#	Remarks
TREATED WATER USING WELL NO.2	W47-0068 OW47-0076 MW47-0465		M47-0175 OP47-0088	

TESTS REQUESTED:

C+DWAPA	C+DWAPD
C+OPOPUP	C+OWOC
C+OWTRI	C+MBDWMF
C+OAPAHX	+CCNAUR
+HCUT	+PHNOL

Sample Class: M Results

Metals in Water ITC

Inquiries at: RAY McVICARS
Telephone: 416-235-5860

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
2	CODE NOT GIVEN	SOUTH RIVER TREATED WATER USING WELL NO.2	M47-0175		16/11/89	14:30	5

Test Description / Code, Units of Measure / Method	Field Sample Number... 2 / M47-0175
URANIUM, UNF TOTAL UUUT ,UG/L as U (Uranium) 001CE5	.07<T
COPPER, UNF TOTAL CUUT ,UG/L as Cu (Copper) 001CE5	3.30
NICKEL, UNF TOTAL NIUT ,UG/L as Ni (Nickel) 001CE5	.11<T
LEAD, UNF TOTAL PBUT ,UG/L as Pb (Lead) 001CE5	.38
ZINC, UNF TOTAL ZNUT ,UG/L as Zn (Zinc) 001CE5	28.00
IRON, UNF TOTAL FEUT ,UG/L as Fe (Iron) 001CE5	2900.00
MANGANESE, UNF TOTAL MNUT ,UG/L as Mn Manganese 001CE5	120.00
SILVER, UNF TOTAL AGUT ,UG/L as AG (SILVER) 001CE5	<.02<W
ALUMINUM, UNF TOTAL ALUT ,UG/L as Al (Aluminum) 001CE5	16.00

Sample Class: M Results

Metals in Water ITC Inquiries at: RAY McVICARS
Telephone: 416-235-5860

Test Description / Code, Units of Measure / Method	Field Sample Number: 2 M47-0175
ARSENIC, UNF TOTAL ASUT ,UG/L as As (Arsenic) 001CE5	<.05<W
BARIUM, UNF TOTAL BAUT ,UG/L as BA (BARIUM) 001CE5	72.00
BORON, UNF TOTAL BBUT ,UG/L as B (Boron) 001CE5	18.00<T
BERYLLIUM, UNF TOTAL BEUT ,UG/L as BE (BERYLLIUM 001CE5	.02<T
CYANIDE,AVAIL.,UNF.REACT CCNAUR,MG/L as CN (Cyanide) 303AC2	<.001<W
CADMIUM, UNF TOTAL CDUT ,UG/L as Cd (Cadmium) 001CE5	<.05<W
COBALT, UNF TOTAL COUT ,UG/L as Co (Cobalt) 001CE5	.49<T
CHROMIUM, UNF TOTAL CRUT ,UG/L as Cr (Chromium) 001CE5	.37<T
MERCURY, UNF TOTAL HGUT ,UG/L as Hg (Mercury) 540AF1	<.01<W
MOLYBDENUM, UNF TOTAL MOUT ,UG/L as Mo Molybdenum 001CE5	.04<T
ANTIMONY, UNF TOTAL SBUT ,UG/L as Sb (Antimony) 001CE5	.29
SELENIUM, UNF TOTAL SEUT ,UG/L as Se (Selenium) 001CE5	<1.00<W
STRONTIUM, UNF TOTAL SRUT ,UG/L as SR (STRONTIUM 001CE5	47.00
TITANIUM, UNF TOTAL TIUT ,UG/L as TI (TITANIUM) 001CE5	14.00
THALLIUM,UNF TOTAL TLUT ,UG/L as TL (THALIUM) 001CE5	<.01<W

Sample Class M Results

Metals in Water ITC

Inquiries at: RAY McVICARS
Telephone: 416-235-5860

Test Description / Code, Units of Measure / Method	Field Sample Number... 2	M47-0175
VANADIUM,UNF,TOTAL VVUT ,UG/L as V (Vanadium) 001CES	.48<T	

Sample Class W Results

WATER (GRND/DOMESTIC) WQ Inquiries at: MIKE RAWLINGS
Telephone: 416-235-5880

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Sampling Time	Zone
2	CODE NOT GIVEN	SOUTH RIVER TREATED WATER USING WELL NO 2	W47-0068		16/11/89	14:30	5

Test Description / Code / Units of Measure / Method	Field Sample Number... 2 — W47-0068
CONDUCTIVITY 25C COND25,UMHO/CM at 25 D.CENT. 002BI2	103.
HARDNESS, TOTAL HAPDT ,MG/L as CACO3 CALC01	20.4
CALCIUM, UNF REACTIVE CAUR ,MG/L as Ca (Calcium) 002CA1	5.5
MAGNESIUM, UNF REACTIVE MGUR ,MG/L as Mg Magnesium 001CA1	1.65
SODIUM, UNF REACT NAUR ,MG/L as Na (Sodium) 001EA1	8.1
ALKALINITY,TOTAL ALKT ,MG/L as CACO3 004AT6	10.2
PH (-LOG(H+(CONCN))) PH ,DIMENSIONLESS 003AI2	6.50
FLUORIDE, UNF REACTIVE FFIDUR,MG/L as F (Fluoride) 003AC2	.04
CHLORIDE, UNF REACTIVE CLIDUR,MG/L as Cl- Chloride 004BC2	15.80

Sample Class W Results

WATER (GRND/DOMESTIC) WQ

Inquiries at: MIKE RAWLINGS
Telephone: 416-235-5880

Field Sample Number...	2
Test Description Code, Units of Measure Method	W47-0068
SULPHATE, UNF REACT SSO4UR,MG/L as SO4 Sulphate 003AI0	7.67
TURBIDITY TURB ,FORMAZIN TURB UNITS 002AI1	1.40
COLOUR, TRUE COLTR ,TRUE COLOUR UNITS 102BC9	9.5
PHOSPHORUS, UNF TOTAL PPUT ,MG/L as P Phosphorus 504AC2	<.002<W
PHOSPHATES, FRAC REACT. PPO4FR,MG/L as P Phosphorus 103DC2	<.0005<W
NITR'N,TOTAL KJELD,UNF.R NNTKUR,MG/L as N (Nitrogen) 004AC2	.130
AMMONIUM,TOTL, FRAC REAC NNHTFR,MG/L as N (Nitrogen) 103DC2	.026
NITRATES,TOTL, FRAC.REAC NNOTFR,MG/L as N (Nitrogen) 102DC2	1.130
NITRITE, FRAC.REACT. NNO2FR,MG/L as N (Nitrogen) 102DC2	.0040<T
PHENOLICS (UNF REACTIVE) PHNOL ,UG/L as PHENOL 002BC2	.6<T

Sample Class ##

Results

DERIVED RESULTS

Inquiries at: WATER QUALITY OFFICE
Telephone: 416-248-3512

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
2	CODE NOT GIVEN	SOUTH RIVER TREATED WATER USING WELL NO.2	DR-CAL		16/11/89	14:30	5

Test Description / Code, Units of Measure / Method	Field Sample Number... 2 / DR-CAL
LANGELIER'S INDEX LANGI ,	-3.1

Sample Class MW

Results

DOMESTIC WATER MICROBIOL

Inquiries at: STEVE DEBRECENI/ROSA LEE
Telephone: 416-235-6011

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
2	CODE NOT GIVEN	SOUTH RIVER TREATED WATER USING WELL NO 2	MW47-0465		16/11/89	14:30	5

Field Sample Number . . . 2

Test Description Code, Units of Measure / Method	MW47-0465
TOTAL COLIFORM MF TCMF ,COUNTS/100 MILLILITRE LF 22	0.
TOTAL COLIFORM MF BKGD TCMFBK,COUNTS/100 MILLILITRE LF 22	0.
STANDARD PLATE COUNT MF HB35MF,COUNTS/MILLILITRE SF 48	2.

Sample Class: OP Results

PRIORITY ORGANICS DWO Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
2	CODE NOT GIVEN	SOUTH RIVER TREATED WATER USING WELL NO 2	OP47-0088		16/11/89	14:30	5

Field Sample Number...	2
Test Description Code, Units of Measure Method	OP47-0088
1,1-DICHLOROETHYLENE X1001P,UG/L Microgram/Litre P0C0D0	<.1<W
DICHLOROMETHANE X1002P,UG/L Microgram/Litre P0C0D0	<.5<W
TRS-1,2-DICHLOROETHYLENE X1003P,UG/L Microgram/Litre P0C0D0	<.1<W
1,1-DICHLOROETHANE X1004P,UG/L Microgram/Litre P0C0D0	<.1<W
CHLOROFORM X1005P,UG/L Microgram/Litre P0C0D0	<.1<W
1,1,1-TRICHLOROETHANE X1006P,UG/L Microgram/Litre P0C0D0	<.02<W
1,2-DICHLOROETHANE X1007P,UG/L Microgram/Litre P0C0D0	<.05<W
CARBONTETRACHLORIDE X1008P,UG/L Microgram/Litre P0C0D0	<.2<W
BENZENE B2001P,UG/L Microgram/Litre P0C0D0	<.05<W

Sample Class OP Results

PRIORITY ORGANICS DUO Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Field Sample Number		2
Test Description Code, Units of Measure	Method	OP47-0088
1,2-DICHLOROPROPANE X1009P,UG/L	Microgram/Litre P0C0D0	<.05<W
TRICHLOROETHYLENE X1010P,UG/L	Microgram/Litre P0C0D0	<.1<W
DICHLOROBROMOMETHANE X1011P,UG/L	Microgram/Litre P0C0D0	<.05<W
TOLUENE B2002P,UG/L	Microgram/Litre P0C0D0	<.05<W
1,1,2-TRICHLOROETHANE X1012P,UG/L	Microgram/Litre P0C0D0	<.05<W
CHLORODIBROMOMETHANE X1013P,UG/L	Microgram/Litre P0C0D0	<.1<W
TETRACHLOROETHYLENE X1014P,UG/L	Microgram/Litre P0C0D0	<.05<W
CHLOROBENZENE X2001P,UG/L	Microgram/Litre P0C0D0	<.1<W
TOTAL TRIHALOMETHANES X2TTHM,UG/L	Microgram/Litre P0C0D0	<.50<W
ETHYLBENZENE B2003P,UG/L	Microgram/Litre P0C0D0	<.05<W
ETHYLENE DIBROMIDE X2EDB ,UG/L	Microgram/Litre P0C0D0	<.05<W
P-XYLENE B2004P,UG/L	Microgram/Litre P0C0D0	<.1<W
M-XYLENE B2005P,UG/L	Microgram/Litre P0C0D0	<.1<W
BROMOFORM X1015P,UG/L	Microgram/Litre P0C0D0	<.2<W
O-XYLENE B2006P,UG/L	Microgram/Litre P0C0D0	<.05<W

Sample Class OP Results

PRIORITY ORGANICS DWO

Inquiries at: BILL BERG / WALTER OFFENBACHER 235-5908
Telephone: 416-235-5907

Test Description / Code. Units of Measure / Method	Field Sample Number. . 2 OP47-0088	
1,1,2,2-TETRACHLOROETHANE X1016P,UG/L Microgram/Litre P0C0D0	<.05<W APS	
1,4-DICHLOROBENZENE X2002P,UG/L Microgram/Litre P0C0D0	<.1<W	
1,3-DICHLOROBENZENE X2003P,UG/L Microgram/Litre P0C0D0	<.1<W	
1,2-DICHLOROBENZENE X2004P,UG/L Microgram/Litre P0C0D0	<.05<W	
STYRENE B2003P,UG/L Microgram/Litre P0C0D0	.05<T UCS	

Results

Sample Class OW

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Field Sample	Sampling Location	Sampling Location Description / Sample Description	LAB Sample#	Remarks	Sampling Date	Time	Zone
2	CODE NOT GIVEN	SOUTH RIVER TREATED WATER USING WELL NO.2	OW47-0076		16/11/89	14:30	5

Test Description Code, Units of Measure	Method	Field Sample Number... 2 / OW47-0076
AMETRYNE P2AMET,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
PROMETONE P2PROM,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
PROPAZINE P2PROP,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
ATRAZINE P2ATRA,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
PROMETRYNE P2PROY,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
SIMAZINE P2SIM ,NG/L (Nanogram/Litre)	W0IP3V	<50.<W
SENCOR P2SENC,NG/L (Nanogram/Litre)	W0IP3V	<100.<W
BLADEX P2BLAD,NG/L (Nanogram/Litre)	W0IP3V	<100.<W
ATRATONE P2ATRO,NG/L (Nanogram/Litre)	W0IP3V	<50.<W

Sample Class OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Field Sample Number...	2
Test Description Code, Units of Measure Method	OW47-0076
DETHYLATED ATRAZINE P2DATR,NG/L (Nanogram/Litre) W01P3V	<200. <W
METALACHLOR POMET ,NG/L (Nanogram/Litre) W01P3V	<500. <W
LASSO POLASS,NG/L (Nanogram/Litre) W01P3V	<500. <W
DIETHYL SIMAZINE P2DSIM,NG/L (Nanogram/Litre) W01P3V	<200. <W
HEXACHLOROETHANE X2HCE ,NG/L (Nanogram/Litre) W04B1X	<1. <W
135-TRICHLOROBENZENE X2135 ,NG/L (Nanogram/Litre) W04B1X	<5. <W
124TRICHLOROBENZENE X2124 ,NG/L (Nanogram/Litre) W04B1X	<5. <W
HEXACHLOROBUTADIENE X1HCBD,NG/L (Nanogram/Litre) W04B1X	<1. <W
123TRICHLOROBENZENE X2123 ,NG/L (Nanogram/Litre) W04B1X	<5. <W
2,4,5-TRICHLOROTOLUENE X2T245,NG/L (Nanogram/Litre) W04B1X	<5. <W
2,3,6-TRICHLOROTOLUENE X2T236,NG/L (Nanogram/Litre) W04B1X	<5. <W
1235TETRACHLOROBENZENE X21235,NG/L (Nanogram/Litre) W04B1X	<1. <W
1245 TETRACHLOROBENZENE X21245,NG/L (Nanogram/Litre) W04B1X	<1. <W
2,6,a-TRICHLOROTOLUENE X2T26A,NG/L (Nanogram/Litre) W04B1X	<5. <W
1234TETRACHLOROBENZENE X21234,NG/L (Nanogram/Litre) W04B1X	<1. <W

Sample Class OW . Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Field Sample Number...	2
Test Description Code, Units of Measure Method	OW47-0076
PENTACHLOROBENZENE X2PNCB,NG/L (Nanogram/Litre) W04B1X	<1.<W
PCB, TOTAL P1PCBT,NG/L (Nanogram/Litre) W04B1X	<20.<W
HEXACHLOROBENZENE X2HCB ,NG/L (Nanogram/Litre) W04B1X	<1.<W
HEPTACHLOR P1HEPT,NG/L (Nanogram/Litre) W04B1X	<1.<W
ALDRIN P1ALDR,NG/L (Nanogram/Litre) W04B1X	<1.<W
PP-DDE P1PPDE,NG/L (Nanogram/Litre) W04B1X	<1.<W
MIREX P1MIPX,NG/L (Nanogram/Litre) W04B1X	<5.<W
A-BHC HEXACHLOROCYCLOHEX P1BHCA,NG/L (Nanogram/Litre) W04B1X	<1.<W
B-BHC HEXACHLOROCYCLOHEX P1BHCB,NG/L (Nanogram/Litre) W04B1X	<1.<W
G-BHC HEXACHLOROCYCLOHEX P1BHCG,NG/L (Nanogram/Litre) W04B1X	<1.<W
A-CHLORDANE P1CHLA,NG/L (Nanogram/Litre) W04B1X	<2.<W
G-CHLORDANE P1CHLG,NG/L (Nanogram/Litre) W04B1X	<2.<W
OXYCHLORDANE P1OCHL,NG/L (Nanogram/Litre) W04B1X	<2.<W
OP-DDT P1OPDT,NG/L (Nanogram/Litre) W04B1X	<5.<W
PP-DDD P1PPDD,NG/L (Nanogram/Litre) W04B1X	<5.<W

Sample Class: OW Results

ORGANIC WATER DWS

Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description / Code, Units of Measure / Method	Field Sample Number... 2
	OW47-0076
PP-DDT P1PPDT,NG/L (Nanogram/Litre) W04B1X	<5.<W
DMDT METHOXYCHLOR P1DMDT,NG/L (Nanogram/Litre) W04B1X	<5.<W
HEPTACHLOREPOXIDE P1HEPE,NG/L (Nanogram/Litre) W04B1X	<1.<W
ENDOSULFAN I P1END1,NG/L (Nanogram/Litre) W04B1X	<2.<W
DIELDRIN P1DIEL,NG/L (Nanogram/Litre) W04B1X	<2.<W
ENDRIN P1ENDR,NG/L (Nanogram/Litre) W04B1X	<5.<W
ENDOSULFAN II P1END2,NG/L (Nanogram/Litre) W04B1X	<5.<W
ENDOSULFAN SULPHATE P1ENDS,NG/L (Nanogram/Litre) W04B1X	<5.<W
OCTACHOROSTYRENE X20CST,NG/L (Nanogram/Litre) W04B1X	<1.<W
TOXAPHENE P1TOX ,NG/L (Nanogram/Litre) W04B1X	<500.<W
PHENANTHRENE B3001X,NG/L (Nanogram/Litre) X3H1D1	<10.<W
ANTHRACENE B3002X,NG/L (Nanogram/Litre) X3H1D1	<1.<W
FLUORANTHENE B3003X,NG/L (Nanogram/Litre) X3H1D1	<20.<W
PYRENE B3004X,NG/L (Nanogram/Litre) X3H1D1	<20.<W
BENZ(A)ANTHRACENE B3005X,NG/L (Nanogram/Litre) X3H1D1	<20.<W

Sample Class: OW Results

ORGANIC WATER DWS Inquiries at: DAVID HALL
Telephone: 416-235-5910

Test Description Code, Units of Measure Method	Field Sample Number...	2				
		OW47-0076				
CHRYSENE B3006X,NG/L (Nanogram/Litre) X3H1D1		<50. <W				
DIMETH.BENZ(A)ANTHRACENE B3007X,No Units available		1QU				
BENZO(E)PYRENE B3008X,NG/L (Nanogram/Litre) X3H1D1		<50. <W				
BENZO(B)FLUORANTHENE B3010X,NG/L (Nanogram/Litre) X3H1D1		<10. <W				
PERYLENE B3011X,NG/L (Nanogram/Litre) X3H1D1		<10. <W				
BENZO(K)FLUORANTHENE B3012X,NG/L (Nanogram/Litre) X3H1D1		<1. <W				
BENZO(A)PYRENE B3013X,NG/L (Nanogram/Litre) X3H1D1		<5. <W				
BENZO(G,H,I)PERYLENE B3014X,NG/L (Nanogram/Litre) X3H1D1		<20. <W				
DIBENZ(A,H)ANTHRACENE B3015X,NG/L (Nanogram/Litre) X3H1D1		<10. <W				
INDENO(1,2,3-C,D)PYRENE B3016X,NG/L (Nanogram/Litre) X3H1D1		<20. <W				
BENZO(B)CHRYSENE B3017X,NG/L (Nanogram/Litre) X3H1D1		<2. <W				
CORONENE B3019X,NG/L (Nanogram/Litre) X3H1D1		<10. <W				

REMARK CODE EXPLANATIONS

RMK	DESCRIPTION
!QU	NO DATA: QUALITY CONTROLS UNACCEPTABLE.
<T	A MEASURABLE TRACE AMOUNT: INTERPRET WITH CAUTION
<W	NO MEASURABLE RESPONSE (ZERO): <REPORTED VALUE
APS	ADDITIONAL PEAK, SMALL, NOT PRIORITY POLLUTANT
UCS	UNRELIABLE: CONTAMINATION SUSPECTED.

*** END OF REPORT ***

Appendix J

CHEMICAL ANALYSES OF SOIL SAMPLES FROM BURIED TAR POND WASTE AREA, JUNE 1991

REPORT OF ANALYSIS

CLIENT CH2M Hill Engineering Ltd.

ATTENTION Ms. Tammy Middleton

ADDRESS 180 King Street, Suite 600
Waterloo, Ontario
N2J 1P8

PROJECT NO. 91-06137

RECEIVED June 17, 1991

REPORTED June 28, 1991

REISSUED July 4, 1991

Dear Ms. Middleton:

Please find attached your Base Neutral Extractables Reissued Results as per your request for analysis reported on a dry weight basis on samples submitted on June 17, 1991. If you have any further questions or problems with these please do not hesitate to call us.

Respectfully yours,

JEANINE WAUGH,
TRACE ORGANICS SUPERVISOR

THE LIABILITY OF CANVIRO ANALYTICAL LABORATORIES LTD. OR ASSOCIATED FIRMS, EXTENDS ONLY TO THE PRICE OF THE ANALYSIS.

BASE NEUTRAL ACID EXTRACTABLES BY "GC/MS"

IDENTIFICATION		#1 TRENCH 1 - 1m	#2 TRENCH 1 - 2m	#3 TRENCH 3 - 1m	MDL
IDENTIFICATION NO.		06137-01	06137-02	06137-03	
NO	COMPOUND	ug/kg	ug/kg	ug/kg	ug/kg
1	Camphene	<	<	<	9200
2	bis(2-chloroethyl)ether	<	<	<	1440
3	o-Cresol	<	<	<	40
4	m-Cresol	<	<	<	40
5	p-Cresol	<	<	<	40
6	bis(2-chloroisopropyl) ether	<	<	<	360
7	Phenol	<	<	<	240
8	Nitrosodi-n-propylamine	<	<	<	40
9	bis(2-chlorethoxy)methane	<	<	<	40
10	Naphthalene	417	<	7134	40
11	2-Chlorophenol	<	<	<	120
12	2,4-Dimethylphenol	<	<	<	320
13	Indole	<	<	<	80
14	2-methylnaphthalene	1210	<	15100	80
15	1-Methylnaphthalene	1140	<	10900	80
16	4-chloro-3-methylphenol	<	<	<	80
17	2-chloronaphthalene	<	<	<	80
18	1-chloronaphthelene	<	<	<	80
19	2,6-dichlorophenol	<	<	<	80

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		#1 TRENCH 1 - 1m	#2 TRENCH 1 - 2m	#3 TRENCH 3 - 1m	MDL
IDENTIFICATION NO.		06137-01	06137-02	06137-03	
NO	COMPOUND	ug/kg	ug/kg	ug/kg	ug/kg
20	2,4-dichlorophenol	<	<	<	80
21	Diphenyl ether	<	<	<	80
22	2,4,6-trichlorophenol	<	<	<	120
23	Acenaphthylene	<	<	<	80
24	2,4-dinitrophenol	<	<	<	1120
25	2,6-dinitrotoluene	<	<	<	2280
26	4-nitrophenol	<	<	<	4800
27	Acenaphthene	<	<	<	80
28	2,3,5-trichlorophenol	<	<	<	80
29	2,4,5-trichlorophenol	<	<	<	160
30	2,3,4-trichlorophenol	<	<	<	80
31	2,4-dinitrotoluene	<	<	<	2440
32	Fluorene	<	<	4020	80
33	4-chlorophenyl phenyl ether	<	<	<	80
34	4,6-dinitro-o-cresol	<	<	<	37600
35	Total Diphenylamine	<	<	<	80
36	2,3,5,6-tetrachlorophenol	<	<	<	80
37	2,3,4,6-tetrachlorophenol	<	<	<	80
38	2,3,4,5-tetrachlorophenol	<	<	<	80
39	4-bromophenyl phenyl ether	<	<	<	80

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		#1 TRENCH 1 - 1m	#2 TRENCH 1 - 2m	#3 TRENCH 3 - 1m	MDL
IDENTIFICATION NO.		06137-01	06137-02	06137-03	
NO	COMPOUND	ug/kg	ug/kg	ug/kg	ug/kg
40	Phenanthrene	400	<	28400	40
41	Anthracene	414	<	13000	40
42	Pentachlorophenol	<	<	<	40
43	Biphenyl	<	<	785	80
44	Fluoranthene	141	<	4840	40
45	Pyrene	274	<	8130	40
46	Benzybutylphthalate	<	<	<	80
47	Benzo (a) anthracene	67.6	<	1990	40
48	Chrysene	<	<	1750	440
49	bis(2-ethylhexyl)phthalate	458	463	4340	40
50	Di-n-butylphthalate	116	496	<	80
51	Benzo (b) fluoranthene	<	<	2230	80
52	Benzo (k) Fluoranthene	<	<	**	40
53	Benzo (a) pyrene	<	<	1340	40
54	Perylene	<	<	<	40
55	5-Nitroacenaphthene	<	<	<	40
56	Indeno(1,2,3-cd)pyrene	<	<	<	40
57	Dibenzo(ah)anthracene	<	<	<	40
58	Benzo(ghi)perylene	90.0	<	<	40
% RECOVERY OF SURROGATES					
d6-Phenol		*	*	*	
d8-Naphthalene		*	*	*	
d12-Chrysene		*	*	*	

* - Recovery not possible due to dilution and matrix interference.
** - Benzo (b) and (k) fluoranthene coeluted, therefore, result is reported as a total.
NOTE: Samples have NOT been corrected for laboratory blank.

BASE NEUTRAL ACID EXTRACTABLES BY "GC/MS"

IDENTIFICATION		#4 TRENCH 3 - 2m	LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.		06137-04			
NO	COMPOUND	ug/kg	ug/kg	%	ug/kg
1	Camphene	<	<	40	9200
2	bis(2-chloroethyl)ether	<	<	98	1440
3	o-Cresol	<	<	80	40
4	m-Cresol	8800	<	71	40
5	p-Cresol	9010	<	87	40
6	bis(2-chloroisoprcpyl) ether	<	<	37	360
7	Phenol	61500	<	52	240
8	Nitrosodi-n-propylamine	<	<	75	40
9	bis(2-chlorethoxy)methane	<	<	61	40
10	Naphthalene	45900	<	69	40
11	2-Chlorophenol	<	<	83	120
12	2,4-Dimethylphenol	<	<	111	320
13	Indole	<	<	95	80
14	2-methylnaphthalene	90900	<	75	80
15	1-Methylnaphthalene	55500	<	76	80
16	4-chloro-3-methylphenol	<	<	87	80
17	2-chloronaphthalene	<	<	73	80
18	1-chloronaphthelene	<	<	85	80
19	2,6-dichlorophenol	<	<	90	80

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		#4 TRENCH 3 - 2m	LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.		06137-04			
NO	COMPOUND	ug/kg	ug/kg	%	ug/kg
20	2,4-dichlorophenol	<	<	89	80
21	Diphenyl ether	<	<	83	80
22	2,4,6-trichlorophenol	<	<	98	120
23	Acenaphthylene	<	<	89	80
24	2,4-dinitrophenol	<	<	267	1120
25	2,6-dinitrotoluene	<	<	88	2280
26	4-nitrophenol	<	<	63	4800
27	Acenaphthene	<	<	82	80
28	2,3,5-trichlorophenol	<	<	97	80
29	2,4,5-trichlorophenol	<	<	109	160
30	2,3,4-trichlorophenol	<	<	97	80
31	2,4-dinitrotoluene	<	<	77	2440
32	Fluorene	18200	<	86	80
33	4-chlorophenyl phenyl ether	<	<	83	80
34	4,6-dinitro-o-cresol	<	<	152	37600
35	Total Diphenylamine	<	<	75	80
36	2,3,5,6-tetrachlorophenol	<	<	95	80
37	2,3,4,6-tetrachlorophenol	<	<	99	80
38	2,3,4,5-tetrachlorophenol	<	<	104	80
39	4-bromophenyl phenyl ether	<	<	93	80

BASE NEUTRAL ACID EXTRACTABLES (CONT)

IDENTIFICATION		#4 TRENCH 3 - 2m	LAB BLANK	RECOVERY SPIKE	MDL
IDENTIFICATION NO.		06137-04			
NO	COMPOUND	ug/kg	ug/kg	%	ug/kg
40	Phenanthrene	85200	<	67	40
41	Anthracene	49000	<	66	40
42	Pentachlorophenol	<	<	93	40
43	Biphenyl	10400	<	85	80
44	Fluoranthene	4670	<	73	40
45	Pyrene	1220	<	62	40
46	Benzybutylphthalate	<	0.05	66	80
47	Benzo (a) anthracene	5420	<	54	40
48	Chrysene	5060	<	53	440
49	bis(2-ethylhexyl)phthalate	22600	0.19	80	40
50	Di-n-butylphthalate	<	0.33	82	80
51	Benzo (b) fluoranthene	<	<	72	80
52	Benzo (k) Fluoranthene	<	<	74	40
53	Benzo (a) pyrene	<	<	56	40
54	Perylene	<	<	63	40
55	5-Nitroacenaphthene	<	<	66	40
56	Indeno(1,2,3-cd)pyrene	<	<	56	40
57	Dibenzo(ah)anthracene	<	<	51	40
58	Benzo(ghi)perylene	<	<	52	40
% RECOVERY OF SURROGATES					
d6-Phenol		*	30	48	
d8-Naphthalene		*	42	61	
d12-Chrysene		*	31	47	

* - Recovery not possible due to dilution and matrix interference.
NOTE: Samples have NOT been corrected for laboratory blank.

MAPS
NOT
FILMED

CARTES
OMISES